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CHILD DEVELOPMENT

The contents of this number include studies of the factors affecting amount and kind of food eaten, night sleep, and free association of children; reports on bilingual children, temperature variations, and laughter; studies of learning of children, and of the function of home libraries in child development.

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A Study of Factors Affecting the Amount and Kind of Food Eaten by Nursery School Children*

MARION ELIZABETH DUNSHEE

EVER since the opening of the nursery school of the Institute of Child Welfare, University of Minnesota, daily records have been made of the food and eating habits of children at the lunch hour. In the present study 3005 such records made on 37 children between the months of January and July 1927 were analyzed to determine factors influencing the amount and kind of food eaten at this noonday meal.

Because the nursery school movement is so new, completed research on children in such institutions is meager, and a search of the literature has revealed no study of the precise nature of the present one. Imlay (19) conducted a study of the food consumption and food habits of young children and studied the extent to which those habits might be modified by the nursery lunch. She made a home study of the children at meal time, determining the amount and kind of food eaten, as well as their attitude toward the food. The lunch at the nursery school was very carefully balanced as to nutrients and adequate in calories. The same kind of records were kept as those made in the homes. A similar study was made by Barker (5), of the group lunch as a means of solving some problems in feeding the pre-school child. She secured her data by means of questionnaires, observations, and studies of 12 nursery school children over a period of two months. Sholley (28) made an analysis of nutritional and management problems of 400 children in the pre-school clinics of the Infant Welfare Society of Minneapolis.

Roberts (23) reports a detailed study made by herself and Moseley on reactions to food of children of pre-school age, with special consideration of management as a conditioning factor. One hundred children were observed in their homes through at least one meal and a record was made of the child's attitude, reactions, and the factors influencing his eating. A ques-

* Acknowledgment is made of indebtedness to the forty-six students in the course in Field Work in Nutrition, whose carefully kept records of the food and eating habits of the nursery school children during their lunch hour furnished the original data for this study.

Appreciation is expressed of the careful examination and criticism of the manuscript by Dr. John E. Anderson, Adviser and Chairman of the Thesis Committee.

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tionnaire was also taken from the mother concerning the factors in his earlier years which might account for his present attitudes. In June, 1927, Sweeney (29) states that a series of studies were initiated at the Merrill-Palmer School involving "the evaluation of the nursery school atmosphere, the standards of service, the appearance of the food and the influence of the nursery school personnel." The details of the studies are not evident from the report and it appears that they are not completed.

The records used in this study were kept by students in the course in field work in nutrition, under the supervision of Dr. Jane Leichsenring. Each student ate lunch at a table with three of the children and during the meal or immediately after filled out a record blank for each child. The record blank will indicate what the student had to report: the kind of food, the

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General record of food and eating habits of nursery school children at lunch

Sat down at.....Left table at.....Name of child.....Date.....

FOOD	KIND	AMOUNT	EXTRA	AMOUNT UNEATEN	ATTITUDE				URGED	HELPED TO FINISH
					With relish	As matter of course	Disliked but ate	Refused		
Vegetable cooked										
Vegetable uncooked										
Potato or substitute										
Protein food										
Sandwich										
Crusts										
Milk										
Dessert or fruit										

A. Appetite: very hungry, hungry, indifferent, little, none.

B. General attitude: alert, normal, fatigued, sleepy.

C. Attitude toward other children: disregarding, matter of fact, interested, distracted, disturbed whom.....disturbed by.....

D. Attitude toward visitors: unaware, casual, aware, distracted.

E. Attitude toward adult at table: demonstrative, matter of fact, ignored, antagonistic.

F. Conversation at table: none, quiet, normal, talkative, very talkative.

G. Bodily activity during meal: very quiet, quiet, average, restless, very restless.

H. Ability to feed self:

1. Spilling: none, little, much.

2. Handling of utensils: Knife....., fork....., spoon.....

I. Manner of eating: eats rapidly, at average speed, slowly. Child is first through in room, last through in room. Takes: very small bites, average bites, large bites.

J. Serving food: Coördination: very good, good, average, poor, very poor Spilled.....Dropped.....

K. Training method used: Praise, favorable comparisons, critical comments, timing, reward, example, others.....

amount eaten, the attitude of the child toward the food, whether he had to be urged, or helped, his attitude toward various people in the room, and his general reaction to his environment. Since this study extended over two quarters and a summer term of school, it was inevitable that the personnel of the students would change several times, with the result that forty-six students made the 3005 records. Furthermore not all the children were present from the beginning of the period. For that reason the range in number of records is large, from 22 to 108 with a mean of 81.5.

For the purpose of analysis these data were approached from two angles: (a) a study of the factors affecting the amount of food eaten, and (b) a study of the factors affecting the kind of food eaten.

AMOUNT OF FOOD EATEN

Since the amount of food eaten was expressed in various units of measure such as fractions of a cup, slices (of bread), or numbers of pieces, it was decided to convert the amount of food into terms of calories. Accordingly the caloric value of all the food used was determined, and from these data the total number of calories consumed by each child each day was computed and the mean amount for each child estimated. These data furnished a basis for studying the following factors which conceivably might influence the amount of food eaten: age, sex, time spent at the table, the person in charge of the table, the child's attitude toward his food, the season of the year, the child's activity, and the training methods used.

KIND OF FOOD EATEN

The second part of this study was concerned with the factors affecting the kind of food that the nursery school children ate. So far as the kind of food placed before him was concerned the child had no choice, but whether or not he ate the food was a different matter. When the children's attitudes toward food were worked out it became evident that the percentages of refusals and of "disliked but ate" were very low indeed; a mean of 2.23 per cent for refusals and 3.25 per cent for dislikes. These records were analyzed to determine, if possible, the factors responsible. The foods were divided into five major groups: milk, protein foods other than milk, vegetables, carbohydrate foods, and desserts and the number of refusals of each food within each group tabulated and summarized. From these data the total number of refusals for each food was obtained and the percentage of times refused in relation to the number of times offered was estimated. A like process was followed in the case of the records of "disliked but ate." The records of the refusals and "disliked but ate" in percentages were then summarized.

Since this study began with records which were made January nineteenth, and most of the children had been in the nursery school at least since fall, and in a number of cases longer, it was reasonable to suppose that the attitude toward their food had been influenced by this residence. To determine its affect, correlations were made between each attitude and the length of nursery school attendance. Partial correla-

tions were made in which age was held constant for nursery school attendance and the attitudes "with relish," "matter of course," and "refused." The correlation between nursery school attendance and the attitude "disliked but ate" showed so little relationship that age was not partialled out.

RESULTS

In a consideration of the results of this study it is necessary to keep some of the limitations of the data in mind. The number of cases is small, 37, and for that reason the results may be considered to point out general tendencies only. The period of time covered does not take in the fall months, the inclusion of which might show greater seasonal differences in the amount of food eaten and the number of refusals made.

Inspection of the standard deviations in table 1 shows a wide dispersion from the mean number of calories eaten in a number of cases. In all instances this was due to one or two cases at the upper or lower extremities of the distribution. Unquestionably, this fact reduces the reliability of the results. In all correlations the means were used. This was a shorter method but somewhat less accurate than if the original day's records had been used. The expression of the time that the children ate "with relish" etc. in terms of percentages also influences the correlations, for it stands to reason that if the child eats with relish 85 per cent of the time he cannot assume the other attitudes more than a total of 15 per cent of the time.

TABLE 1

Means and standard deviations of calories per meal per child

CHILD	AGE	MEAN	S.D.
	months		
David B.	37	430	72.5
Mary B.	27	443	61.5
David Bu.	48	473	65
Joe C.	22	440	68
Gwendolyn C.	38	451	57.5
Robert DeL.	43	477	57.5
Anna D.	43	449	115
John E.	29	400	112.5
Quentin E.	37	479	57.5
Mary F.	28	423	62.5
Donald F.	35	468	45
Ray F.	44	457	65
Robert G.	39	453	75
Elaine H.	41	472	72.5
Pollyanna J.	27	450	65
Harriet L.	56	460	80
Irene LaV.	33	383	92.5
Paul L.	56	480	47.5
Richard L.	39	453	82.5
Clayton L.	47	475	70
Roger L.	33	454	72.5
John L.	44	555	105
Grace M.	35	453	87.5
Margaret P.	46	433	77.5
Helen P.	52	488	62
Dorothea Q.	31	417	86.5
Dorothy Q.	50	508	85
Robert Q.	27	455	50
Lawrence S.	51	485	55
John S.	29	433	91.5
Richard S.	45	487	80
Catherine S.	41	489	70
John T.	22	351	110
Joan W.	53	488	67.5
Claire W.	41	470	85
Mary W.	41	478	70
Richard W.	28	440	75

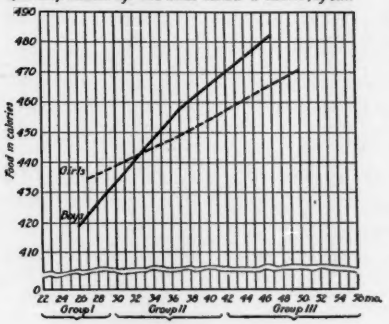
Factors affecting the amount of food eaten

Table 1 gives the means and standard deviations of calories per meal for each child. It shows not only great variability for individual children, but also considerable variation within the group, a fact which comes out in all the factors studied.

Age and sex. To study the influence of age and sex on the amount of food eaten, the children were divided into three age groups: the first, from 1 year and 6 months to 2 years and 5 months; the second, from 2 years and 6 months to 3 years and 5 months; and the third, from 3 years and 6 months to 4 years and 8 months. These groups in turn were divided according to sex. That gave 3 girls and 6 boys in the first group 8 girls and 8 boys in the second group; and 6 girls and 8 boys in the third group; making a total of 16 girls and 21 boys. These groups are small, but when the number of records is considered (table 2) the results may be given some weight. The mean number of calories by age and sex are shown in fig. 1 and the accompanying table.

Fig. 1

Relationship between age and mean number of calories, by sex.



Groups	Mean age		Mean calories	
	Boys	Girls	Boys	Girls
I	26.1	27.3	419	435
II	37.3	37.1	458	449
III	47.2	50.	482	471
Mean number calories for all boys 457				
Mean number calories for all girls 455				

There are slight differences in the mean number of calories eaten by Group I and Group II, and between Group II and Group III, but the difference only becomes statistically significant when Groups I and III are compared. Here the difference divided by its standard error is 4.17. The sex difference in Group I, as shown by the difference divided by the standard error of a difference is 1.03; in Group II, .64; and in Group III, .91; indicating that there is no significant difference. When all the boys are compared with all the girls the difference becomes still less significant, with a mean of 455 and a standard deviation of 31.3 in the case of the girls and a mean of 457 and a standard deviation of 28.6 in the case of the boys.

Time spent at the table. Table 3 shows that the average length of time spent at the table during the period studied ranged from 21 to 49 minutes, with a mean of 34 and a standard deviation of 6.32 for the group as a whole. This makes an average of considerably less than 45 minutes, as given by Barker (5).

The correlation between the mean amount of time spent at the table and the mean number of calories eaten per day ($-.65 \pm .06$) (table 4) would tend to show that in general the child who stays at the table longest eats less food. This coincides with the general impression that the child who dawdles or plays with his food eats comparatively

little and that the child who enjoys his food eats more and eats it more rapidly. The correlation between the length of number of calories eaten per day becomes −.55. It would appear then that age is a slight factor, but that

TABLE 2

Number of records upon which data are based

Age	1:6–2:5				2:6–3:5				3:6–4:8			
Sex	Boys		Girls		Boys		Girls		Boys		Girls	
	J. C.	38	M. B.	81	D. B.	97	G. C.	78	D. B.	94	A. D.	98
	J. E.	73	M. F.	49	Q. E.	105	E. H.	106	R. D.	78	H. L.	81
	R. Q.	95	P. J.	76	D. F.	72	I. L.	89	R. F.	54	M. P.	62
	J. S.	95			R. G.	98	G. M	73	P. L.	68	H. P.	82
	J. T.	22			R. L.	88	D. Q.	45	C. L.	93	A. D.	98
	R. W.	89			R. L.	85	C. S.	103	J. L.	62	J. W.	93
					C. W.	97	M. W.	92	L. S.	88		
									R. S.	108		
Number of records		412		206		642		596		645		514
Grand total												3,005

TABLE 3

Means and standard deviations of time spent at the table

CHILD	MEANS	S.D.	CHILD	MEANS	S.D.	CHILD	MEANS	S.D.
	minutes			*minutes*			*minutes*	
David B.	42	9.22	Robert G.	31	6.22	Helen P.	33	6.71
Mary B.	35	8.95	Elaine H.	29	7.07	Dorothea Q.	41	9.75
David Bu.	35	7.75	Pollyanna J.	34	8.06	Dorothy Q.	26	6.71
Gwendolyn C.	36	11.18	Harriet L.	35	7.42	Robert Q.	29	7.75
Gwendolyn C.	36	6.89	Irene LaV.	47	10.73	Lawrence S.	21	7.07
Robert DeL.	26	6.89	Paul L.	29	6.52	John S.	35	10.25
Anna D.	37	8.95	Richard L.	36	11.18	Richard S.	32	7.42
John E.	41	11.83	Clayton L.	26	5.70	Catherine S.	37	7.07
Quentin E.	32	6.13	Roger L.	31	7.07	John T.	44	7.07
Mary F.	45	10.25	John L.	29	7.07	Joan W.	25	6.33
Donald F.	29	8.37	Grace M.	36	9.75	Claire W.	26	6.89
Ray F.	35	8.66	Margaret P.	49	10.95	Mary W.	30	8.37
						Richard W.	33	8.06

Range of mean amount of time spent at the table 21 to 49 minutes
Mean 34 minutes S.D. 6.32 minutes

time spent at the table and age is −.43 ±.12 and when age is held constant the correlation between the length of time spent at the table and the mean there is a significant, although not high, degree of negative relationship between the time the child spends at the table and the amount of food he eats.

TABLE 4

*Correlations**

	r	P.E.	PARTIAL CORRELATIONS, AGE CONSTANT
I. Mean number of calories per day with:			
Time spent at the table	−.65	±.06	−.55
Length of nursery school attendance	.40	±.09	.017
Percent of time food eaten "with relish"	.68	±.06	.67
Percent of time food eaten "as a matter of course"	−.57	±.07	−.50
Percent of time food "disliked but ate"	−.39	±.10	
Percent of time food was refused	−.62	±.07	−.58
Number of urgings	−.53	±.08	−.50
Number of times help was given	−.44	±.09	−.42
Bodily activity	.11	±.11	.057
Conversation at the table	.37	±.09	.016
Attitude toward other children	.12	±.11	−.21
Attitude toward adult at table	.23	±.10	.014
Attitude toward visitors	.20	±.11	.03
Praise	.18	±.11	
Favorable comparison	.15	±.11	
Critical comment	.23	±.11	
Timing	−.33	±.10	
Reward	.09	±.10	
Example	−.24	±.10	
II. Age with:			
Mean number of calories	.70	±.06	
Time spent at table	−.43	±.12	
Length of nursery school attendance	.56	±.07	
Percent of time food eaten "with relish"	.33	±.09	
Percent of time food eaten "as a matter of course"	−.33	±.09	
Percent of time food "disliked but ate"	.02	±.11	
Percent of time food was refused	−.33	±.09	
Number of urgings	−.25	±.10	
Number of times help was given	−.22	±.10	
Bodily activity	.10	±.11	
Conversation at the table	.51	±.08	
Attitude toward other children	.37	±.09	
Attitude toward adult at table	.32	±.10	
Attitude toward visitors	.32	±.10	
III. Number of urgings with:			
Percent of times refused	.99	±.006	
Percent of times "disliked but ate"	.70	±.06	
IV. Nursery school attendance with:			
Percent of times food eaten "with relish"	.39	±.09	.27
Percent of times food eaten "as matter of course"	−.31	±.10	−.16
Percent of times food "disliked but ate"	−.22	±.11	
Percent of times food was refused	−.31	±.10	−.16

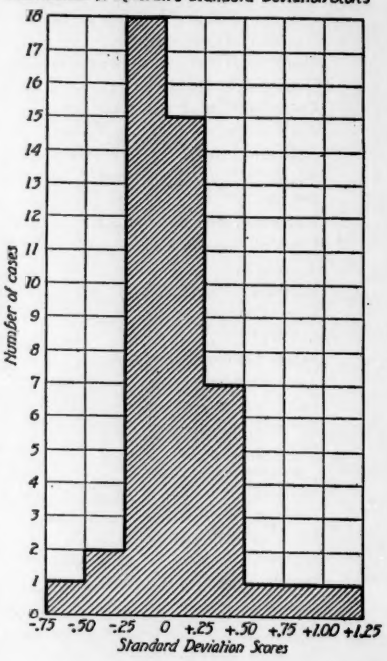
* The Pearson product moment formula was used.

The person in charge. A casual observation of the student in charge of the table would convince one that she was a factor in the amount of food the child ate. This problem was complicated by the fact that there were so many different students in charge. One child had as many as 17 people making records on his food and eating habits, whereas another had but two. The average was seven. Moreover, the number of records made on a given child by the different recorders varied widely. Donald F. had 11 recorders, nine of whom made from 1 to 6 records, and one making as high as 35. The situation was equally complicated when the number of children on which each student made records was considered. Here there was a range from three to twenty-five, with the mean falling at seven.

Two methods for studying the teacher's influence were at last decided upon. (1) The mean number of calories which each child ate when with a given recorder was estimated and converted into his standard deviation score when with that recorder, and then the recorder's standard deviation score was determined. (2) The second method was to use the records of the four people who made reports on the largest number of children (M.M., 25; C.T., 18; H.H., 22; and S.P., 20). In each case the mean amount of food eaten when with the recorder was figured and also the mean amount of food eaten when with all other recorders. The number of cases was so small that the relationship between these means was found by using the Spearman rank order correlation. An examination of the standard deviation scores for individual children revealed that the recorders had a very definite influence on the amount of food the children ate. There were few children whose records indicated no influence.

Fig. 2 gives the distribution of the recorders' standard deviation scores and shows the individual differences at a glance. In 25 cases the recorders tended on the average, to increase the amount of food eaten, although it ranges from the practically negligible increase of +.01 to +1.06. In the case of those recorders who tended to decrease the amount eaten the figures vary from −.002 to −.70. However,

Fig. 2
Distribution of Recorders' Standard Deviation Scores



the majority of instances fall between +.28 and −.25.

The results of the second method used to show the influence of the person in charge on the amount of food the children ate are given in table 5. In all four of these cases the correlations between the mean number of calories eaten when with a given recorder and the mean number of calories eaten when with all other recorders are so small and their probable errors so large that there is little relationship between the two. The standard deviation scores of these individuals show somewhat the same tendency. When with M.M. the children tend to eat more than their average (+.26); when with C.T., more than their average (+.13); when with H. H., less than their average (−.16); and when with S.P. about the same (−.01).

TABLE 5

Correlations between the mean number of calories eaten when with a given recorder and the mean number of calories eaten when with all other recorders

NUMBER OF CASES	RECORDER AND ALL OTHER RECORDERS	r	P.E.
25	M. M. and all other recorders	.01	±.16
18	C. T. and all other recorders	.08	±.16
22	H. H. and all other recorders	.13	±.12
20	S. P. and all other recorders	.19	±.15

The length of nursery school attendance. There was a wide range in the children's attendance at the nursery school, from 22 to 292 days, with a mean of 158 and a standard deviation of 74.8. If the general opinion is true (8), (12), (20), (21), one might expect a fairly high corrleation between the length of attendance and the number of calories eaten. The correlation (table 4) as shown by the coefficient is +.40 ±.09. This indicates, of course, that there is a definite positive relationship, but it is not very high. The correlation between age and nursery school attendance is +.56 ±.11 (table 4) and when age is held constant the coefficient between length of nursery school attendance and mean amount of calories per day becomes .017. It would appear, then, that age is the factor present and that there is practically no relationship between the length of nursery school attendance and the amount of food eaten.

The children's attitude toward their food. Percentages of all the records of attitude reported as "with relish," "matter of course," "disliked but ate," and "refused," and number of times the individual was urged or helped were computed for each child. These percentages showed that in the largest percentage of instances the children ate their food with relish; that in the majority of cases when the children did not eat with relish, their attitude was reported as "matter of course." In only a very low percentage of cases were refusals made or was the attitude "disliked but ate" assumed. Table 6 shows this situation still more clearly. On an average 68 per cent of the time the children ate with relish; 26.8 per cent as a matter of course; 3.25 per cent of the time they "disliked but ate" the

food; while only 2.23 per cent of the time was it refused.

The correlations brought out some interesting relationships (table 4). The coefficient for the per cent of time that food was eaten with relish and the mean number of calories eaten was .68 ±.06, signifying that when children ate with relish they tended to eat more. When age was partialled out the coefficient was .67, so that age would seem to be a negligible factor in this instance. The coefficient of correlation between the per cent of time the food eaten "as a matter of course" and the mean amount of food eaten (−.57 ±.07) indicates a fair degree of negative relationship; with an increase in the amount of food eaten the attitude of "matter of course" decreased in per cent. This is what might be expected in the light of the results for the amount of food and the attitude "with relish." Holding age constant, the coefficient became −.50 so that age may be a small factor.

TABLE 6

Means and standard deviations of attitude toward food

	PER CENT WITH RELISH	PER CENT MATTER OF COURSE	PER CENT DISLIKED BUT ATE	PER CENT REFUSED
Mean	68	26.8	3.25	2.23
S.D.	14.83	11.83	2.4	2.09

The coefficient for "disliked but ate" and the amount of food eaten (−.30 ±.10), while not very high, shows a negative relationship which one might expect,—as the dislike for food increased the amount eaten decreased. There is no relationship between age and the attitude "dislike but ate," as shown by the coefficient of correlation .02 ±.11, therefore age was not partialled out. The relationship between the per cent of refusals and the amount of food eaten (−.62 ±.07) is a fairly large negative one as might be anticipated,—when the per cent of refusals increased the amount of food eaten decreased. With age held constant the relationship becomes −.58; therefore it would appear that age is not important. Coefficients between the number of urging and the amount of food eaten (−.53 ±.08), and the number of times help was given and the amount of food eaten (−.44 ±.09), both show the type of relationship one would look for. Age appears to be a very minor factor in both cases, for when it is held constant —.53 becomes —.50 and —.44, drops only to −.42.

Season. A comparison of the mean amount of food eaten in a three weeks winter period and that eaten in a like period in summer brings out some interesting points. Of the 23 children studied 15 ate less in the summer period than in the winter period, 7 ate more, and 1 ate the same amount. For only three of the children who ate less in summer is the difference statistically significant; and exactly the same number of children ate a significantly greater amount in summer. One may conclude, then, that in these cases studied there is no significant difference in the amount of food eaten during the winter and summer seasons. These findings are interesting in the light of Clayton's (9), quoted above, in which she finds no seasonal variation in growth. They also point to the value of well-balanced meals (26) which

are always served at the nursery school.

Bodily activity during the meal. As will be noted, five degrees of activity were reported upon. Each activity was weighted, the values increasing with increase in activity; i.e., very quiet was given a value of 1; quiet, 2; average, 3; restless, 4; and very restless, 5. From these data a final activity score for each child was evolved by dividing the sum of his daily ratings by the number of records. When the scores for bodily activity were correlated with the mean amount of food eaten (table 4) a coefficient of .11 ±.11 was obtained, showing that there is very little relationship between the two. This is interesting because from casual observations one might infer that the lively children were not still long enough to eat very much. A coefficient of .10±.11 was obtained between bodily activity and age, and when age was partialled out the coefficient between bodily activity and mean number of calories became negligible (.057).

Conversation at the table. Although in the majority of cases the children were reported as either normal or talkative, nevertheless the ratings were treated in the same way as those on activity. In the weighting increasing values were given to the points indicating more conversation: none received a value of 1; quiet, 2; normal, 3; talkative, 4; and very talkative, 5. When the final scores for conversation were correlated with the mean amount of food the children ate (table 4), a coefficient of .37 ±.09 was obtained. Thus there seems to be some positive relationship between the amount of food eaten and conversation. There is a higher positive relationship, however, between the amount of conversation at the table and the age of the children (.51 ±.08). Moreover, when age is held constant the coefficient .37 becomes .016, so that one may assume that age is probably the significant factor in the relation between food consumption and conversation at the table.

Attitude toward other children. Little children are very much interested in one another. When they are gathered together as they are during the nursery school lunch period, are they so distracted by one another's presence that it interferes with the amount of food they eat, or is there no effect? The records which were kept make it possible to answer this question in the case of this nursery school. The student reported the child's attitude according to the following points: disregarding, matter of fact, interested, distracted, disturbed by, disturbed whom. These data were treated as in bodily activity, the weighting being done according to degree of distraction. The correlation between the final scores on attitude toward other children and the mean number of calories eaten (.12 ±.11) (table 4) shows that there is not much relationship between the two. When age is held constant a low negative relationship (−.21) is evident. For the most part, then, there is no connection between the amount of food eaten and degree to which the children may be distracted by one another.

Attitude toward adult at the table. Another way of getting some idea as to the influence of the student on the children at her table was made possible by the records kept on the child's atti-

tude. Four possible attitudes were given: demonstrative, matter of fact, ignored, and antagonistic. These data were also treated like those on bodily activity. The weighting was done so that the value increased with the increasing attention the child paid to the student. Individual scores showed that most of the time the children were matter of fact in their manner toward the student in charge; they were frequently demonstrative, but seldom ignored or were antagonistic. When the score on this attitude was correlated with the mean amount of food eaten there appeared to be comparatively little relationship (.23 +.10). Here again, when age was held constant the relationship became negligible (.014).

Attitude toward visitors. Since the nursery school at the Institute is a research center and serves as a laboratory for study of the young child, there are a good many visitors during the course of the year. In fact it is an exceptional day when six or eight adults are not seated in each room during the lunch hour. They are requested to make themselves as inconspicuous as possible but under the best of circumstances one may question as to whether or not their presence is a disturbing factor. With the idea of determining just how distracting the visitors might be, the child's attitude toward visitors was included in the record. Four conditions were listed: unaware, casual, aware, and distracted. In working up the data the writer tabulated the material as in bodily activity. In the weighting, the values were graded according to the increasing degree of distraction. Each child's final score was correlated with his mean number of calories per meal (table 4). In most instances the children were either unaware of the adults or assumed a casual attitude toward them. The coefficient of correlation (.20 ±.11) between the scores on the attitude toward visitors and the mean amount of calories eaten reveals low relationship between the two. There is a closer relationship between the scores obtained on attitude toward visitors and age (.32 ±.09), and when age is held constant the relationship between attitude toward visitors and amount of food eaten practically disappears (−.03).

The effect of the training method used. Individual scores for the use of each training method were worked out in percentage. Of the six methods praise was used most often, favorable comparison next most often, and the other four methods—critical comment, timing, reward, and example—were employed approximately an equal number of times. Generally speaking, the correlations between these various training methods and the average amount of food eaten indicate little relationship (table 4). The correlations with praise (.18 +.11), favorable comparison (.15 ±.11), and critical comment (.23 +.11), have such high probable errors that the relationships become negligible, that with reward (.09 ±.11) is so small as to show practically no relationship, and those with timing (−.33 ±.10) and with example (−.24 ±.10) express some negative relationship, but here, too, the probable errors are so high that the correlations lose their significance. One seems justified in concluding that, on the whole, there is little connection

between the amount of food these nursery school children ate and the different methods of training employed.

The relative influence of various factors on the mean number of calories eaten. With the purpose of checking the correlations and confirming the relationships already obtained the 10 children eating the most food were compared with the ten eating the least. The two methods yielded very similar results. (See table 7.) The children of Group A ate more food on the average than those in Group B; they are also older than Group B; both facts are in agreement with the correlation between age and mean number of calories eaten, .70 ±.06. The children who spend the shortest time at the table (mean, 29 minutes) are Group A; those who stay at the table longest (mean, 41 minutes) are Group B. These confirm the correlation of −.65 between the time spent at the table and mean number of calories eaten. The percentage of records showing that children ate with relish is higher for Group A; while Group B exceeds Group A in per cent of records in each of the three unfavorable attitudes, matter of course, disliked but ate, and refused, urged and helped. All these differences are con-

TABLE 7

Influence of various factors on mean number of calories eaten

	GROUP A 10 CHILDREN WHO ATE MOST		GROUP B 10 CHILDREN WHO ATE LEAST	
	Mean	S.D.	Mean	S.D.
Calories	494	21.9	414	26.8
Age in months	47	5.91	32.6	7.25
Time at table (min.)	29	4.33	41	5.0
Attitude toward food:				
Percent with relish	78.6	9.7	53.0	11.2
Percent matter of course	18.0	7.7	38.0	9.58
Disliked but ate	2.2	1.64	5.2	9.57
Refused	0.6	0.63	3.9	2.71
Urged to eat	10	3.59	18.9	13.6
Helped	2.3	3.59	18.9	13.6
Attendance	198	54.6	109	52.37
Activity	3.16	1.28	3.13	4.89
Conversation	3.61	.42	3.11	.24
Attitude to other children	3.14	.33	2.97	.5
Attitude to adult	3.26	.20	3.06	.18
Attitude to visitors	1.49	.26	1.39	.23
Training methods:				
Praise	35.5	11.45	34.7	11.44
Favorable comparison	23.5	5	21.8	6.16
Criticism	10.3	5.39	8.6	5.38
Timing	10.0	5.0	15.5	6.7
Reward	13.8	4.33	11.5	4.89
Example	7.6	4.0	8.0	5.74

sistent with the correlations reported in table 4.

The children who have attended the nursery school the longest (mean, 198 days) are those who eat the most (Group A), and those who have attended the nursery school the shortest length of time (mean, 109 days) eat the least (Group B). This data shows a somewhat higher relationship than the correlation $+.40 \pm .09$. However, it may be that since these children are the older children, age is the chief factor, as would be indicated by the partial correlation, .017.

The group of hearty eaters differed very little from the group of light eaters in the mean ratings for bodily activity, attitudes toward other children, adult at the table, and visitors, and the correlations between food consumed and these factors are correspondingly low. Likewise the two groups differ little in the extent to which praise, favorable comment, criticism, reward, and example were used as a training method, and again the correlations on these factors are low.

Group A shows a higher percentage of talkativeness than Group B, but from the low partial correlation one may suspect that age rather than amount of food eaten is the important factor here. The negative correlation between timing as a training method and food consumption is consistent with the fact that this method is less often used with Group B than with Group A.

Since these two methods of showing relationship, that of correlation and that of obtaining differences between two groups at the extremes, check so closely, it is safe to assume that the results obtained are fairly accurate for the group of children studied.

Factors affecting the kind of food eaten by Nursery School Children

The second part of this study is concerned with the factors affecting the kind of food that the nursery school children ate. Obviously a big factor is the kind of food that is offered them. The meals which were served at the nursery school of the Institute were planned under the direction of the Division of Nutrition, Department of Home Economics of the University of Minnesota. These meals were simple, well-balanced, and took into account all the food nutrients necessary for the maintenance and growth of the preschool child (26).

Sample menus picked at random

I

January 31
Scrambled Eggs
Scalloped Potatotes
Buttered Peas
Lettuce Sandwich
Milk Peach Sauce

II

April 13
Rice and Tomato
Creamed Cabbage
Peanut Butter Sandwich
Milk
Fruit Gelatin Thin Cream

III

May 27
Creamed Fish
Baked Potatotes
Buttered Cabbage
Plain Sandwich
Milk Peach Sauce

IV

June 20
Egg Souffle
Buttered New Potatotes
Creamed Carrots
Lettuce Sandwich
Milk Pear Sauce

The four sample menus above have been picked at random from the meals served these children, and are representative of the type given. A protein dish, eggs, fish, meat, or cottage cheese, was practically always served. In a few cases—when they had soup, or, as in Menu No. II, where the main dish was rice—the protein was provided in some other form, the peanut-butter in the sandwich, for example. Potatoes, a green vegetable (creamed or buttered), sandwiches, milk, and a simple dessert, usually fruit or milk dessert, constituted the rest of the meal.

The order in which these meals were served should be considered. The vegetable, which is rather generally thought to be the least liked of foods, (5), (18), (19), (23), was served first. This practice was instigated with the idea that when an individual is hungry he is more apt to eat food which he dislikes than at other times. The main part of the meal followed, and then the dessert. Measured portions of food were given the children, and the larger children were give somewhat larger amounts. Of course the children had second helpings if they wished.

In the light of the general conditions of the nursery school, the results in the study of the factors influencing the *kind* of food eaten are interesting indeed. Inspection of table 6 shows that on the average, 68 per cent of the time the children ate their food with relish and 26.8 per cent of the time as a matter of course. Plainly, if one eats his food with relish he likes it, and if he eats it as a matter of course he may be considered to have no aversion to it and, doubtless, in most cases has a mild liking for it. Therefore, it seems that one might assume that 94.8 per cent of the time the children ate their food because they liked it. The rest of the time the children were reported as having refused the food or eaten it although they disliked it. The percentage of refusals was very low (2.23). In the light of the common impression of children's food idiosyncracies, an examination of these refusals is enlightening.

Of the 3005 times that milk was offered (table 8), only 22 times was it refused, making a percentage of refusal of .73. And yet mothers frequently state that they find it a big problem to get their children to drink milk. Protein food other than milk was refused but 37 times. The highest percentage of refusals was of eggs, the next highest of fish, and the lowest of meat. However, the small differences in percentage could hardly be considered significant. The total number of times that all vegetables were refused was 47 or 1.56 per cent and the number of times that each individual vegetable was refused was so low that no comparison of the different vegetables could be made. Evidently these children liked vegetables, although the fact that they were served before any other food was given may in part account for the few refusals. These results are illuminating when the studies of Sholley (28), Barker (5), and Imlay (19) are examined. Sholley states, "Vegetables

prove the stumbling block for many children. Probably mothers experience more difficulty getting children to eat vegetables than any other item of the diet." In her conclusion Barker says that her findings showed that every child studied presented some problem so far as vegetables were concerned, and Imlay maintains that "vegetables are the most generally disliked of all classes of foods." All three of these studies included the home situation as well as the nursery school or the preschool clinics. Carbohydrate foods were refused only seventy-four out of 5932 times they were offered which gives a percentage of refusal of 1.24; the percentage of sandwiches, 1.46, although not significant, was practically twice that of the other carbohydrate foods, .74 per cent. The refusals of desserts were listed according to the different kinds of dessert, but here again the total number of refusals was so small, 116, that it did not offer enough difference for comparison.

The total percentage of records of "disliked but ate" was 3.25. Since the correlation between the number of urgings and the percent of records "disliked but ate" was .70 ±.06 it might be inferred that the records of "disliked but ate" showed the influence of the student in charge. Of the total number of times milk was offered, 3005, there were only 36 times that the children "disliked but ate," a percentage of 1.19.

TABLE 8

Record of foods refused or disliked but eaten

FOOD	TIMES OFFERED	REFUSED		DISLIKED BUT ATE	
		Times	Per cent	Times	Per cent
Milk	3,005	22	.73	36	1.19
Other proteins:					
Eggs	875	15	1.71	33	3.77
Salmon	385	5	1.3	15	3.9
Meat	905	8	.88	11	1.21
Cottage Cheese	171	9	5.26	16	9.35
Total	2,336	37	1.62	59	2.56
Vegetables	3,005	47	1.56	161	5.35
Carbohydrates:					
Potatotes, Rice or Spaghetti	2,947	30	.74	101	2.88
Sandwiches	3,005	44	1.46	89	2.96
Total	5,052	74	1.24	190	3.19

An examination of the records of the protein foods other than milk in the category "disliked but ate" shows some interesting comparison, although the records are so few that the comparisons are not significant. The percentage of "disliked but ate" for cottage cheese is 9.35, or more than twice as much as the percentage for eggs, 3.77, or fish, 3.9, which are practically the same. Meat shows much the lowest percent-

age, 1.21, or one-third that for eggs and fish. The number of records of vegetables "disliked but ate," 161, is divided rather generally among the individual vegetables, and these records are also too few to be significant for comparison. The percentage of times "disliked but ate," 5.35, is somewhat higher than that for other foods, however, and lends a little weight to the impression that vegetables are not liked as well as other foods. The common impression that children like carbohydrate foods is borne out by the records, which show that there are only 190 cases of "disliked but ate," or a percentage of 3.19. The 63 records of desserts "disliked but ate" are pretty generally divided among the various desserts. The percentage of times "disliked but ate" is very low, 2.09.

In general there is little difference in the refusals of vegetables, carbohydrate foods, and protein foods other than milk; the refusals of milk are somewhat lower than of these foods; and of desserts a little more than twice as high. In all cases, however, the percentages are too low to be very significant. There is more variation in the percentage of records of "disliked but ate," the percentage for vegetables being enough higher than the others to indicate more of a dislike for these foods than for the others. Nevertheless, the total records of "disliked but ate," 3.25 per cent, is too low to have much weight.

Length of nursery school attendance apparently had some influence on the various attitudes which the children assumed toward their food. The correlation coefficient for length of nursery school attendance and "with relish" ($.39 \pm .09$) indicates that to a certain extent the longer the child has been in the nursery school the more likely he is to eat with relish. (See table 4.) Age seems to be something of a factor here, for when it is held constant the coefficient drops to .27. According to the coefficient for length of nursery school attendance and "as a matter of course," $-.31 \pm .10$, the child tends to eat less as a matter of course the longer he has been in the nursery school. Age appears to enter here, too, for when partialled out the coefficient becomes $-.16$. There is little relationship between the length of nursery school attendance and "disliked but ate," according to the coefficient $-.22 \pm .11$. Age apparently does not enter in, because the coefficient for "disliked but ate" and age is $.02 \pm .11$. The coefficient for nursery school attendance and "refused" is $-.31 \pm .10$, the same as for "matter of course," and with age held constant becomes $-.16$.

These results are consistent with one another but do not indicate as high a degree of relationship as one might expect. They do indicate that, atleast in a small measure, the children's attitude toward their food improves with attendance at the nursery school. It is possible that greater improvement might have been shown if the records had been available for the earlier months of the school year.

Since on the average 94.8 per cent of the records on the attitude of the children toward their food indicate that the children ate their food because they liked it, and a study of the records of refusals and "disliked but ate" shows relatively little difference in liking for the different foods, it seems

fair to assume that the chief factor in the kinds of food eaten by these children is the fact that they liked it. This evidence of liking the various foods is so marked in contrast to the idiosyncrasies reported in the home —Roberts and Moseley (23), Barker (5), Blanton and Blanton (6), W. R. P. Emerson (13), Gruenberg (18), Imlay (19), Mohr (21), Rice (22), Schmidt (27), Sholley (28), and Anderson and Foster (2)—that one is forced to the conclusion that the nursery school situation is responsible. Miss Lydia Roberts, University of Chicago, one of the foremost students of child nutrition today, voices a similar conclusion when she says, "Perhaps the most effective agency now existing for improving child nutrition is the nursery school" (23).

SUMMARY

1. Records of the food and eating habits of the nursery school children at the institute of Child Welfare, the University of Minnesota were studied statistically to determine some of the factors affecting the amount and kind of food eaten by these children. There were 3005 records made on 37 children by 46 students over a period of 7 months and 10 days.

2. There is no sex difference in the amount of food eaten by these children. A significant age difference is evident only between the youngest group of children, ages 1:6—2:5, and the oldest group, 3:5—4:8, the D.S.E. of D being 4.17.

3. The children who stay at the table the longest time on the average tend to eat less food, as indicated by the coefficient of correlation, $-.65 \pm .06$. Even when age is held constant this relationship is maintained, although to a somewhat less degree, (r is $-.55$).

4. The influence of the students in charge of the children when at their tables at lunch time was shown by the students' standard deviation scores. With some students the children ate more than their average, with some cases less, and sometimes there was no difference.

5. The correlation between the amount of food eaten and the length of nursery school attendance is positive, but the coefficient is not very high—$.40 \pm .09$. Moreover, when age is held constant the coefficient becomes .017, so that age seemed to be the chief factor.

6. Four different attitudes of the children toward their food were reported: "with relish," 68 per cent of the time; "as a matter of course," 26.8 per cent of the time; "disliked but ate," 3.25 per cent of the time; and "refused,' 2.23 per cent of the time. The scores on these attitudes were correlated with the mean number of calories eaten daily. The correlation with "with relish" was $.68 \pm .06$; with "matter of course," $-57 \pm .07$; with "disliked but ate," $-.39 \pm .10$; and with refusals, $-.62 \pm .07$. All these relationships are in accord with expectation.

7. The number of urgings and the amount of food eaten ($-.53 \pm .08$), and the number of times help was given and the amount of food eaten ($-.44 \pm .09$), point out the inverse relationship that would be anticipated.

8. There is no significant difference in the mean amount of calories eaten by these children in the winter and in the summer months, as determined by

D.S.E. of D. These findings are interesting in the light of Clayton's (9), who finds no seasonal variation in growth.

9. The relationship between bodily activity during the meal and the amout of food eaten is very low—.11±.11. With age constant it becomes negligible—.057.

10. The conversation at the table other part of the child and the amount of food he eats apparently have little in common. The coefficient of correlation is .37 ±.09, and with age partialled out it becomes .016.

11. There is little relationship between the amount of food the children eat and their attitude toward one another, according to the correlation, .12 ±.11.

12. That the attitude toward the student at the table did not have a very marked influence on the amount of food the children ate is evident from the correlation of 23 ±.10 between it and the mean amount of food eaten.

13. The coefficient of correlation between the amount of food eaten and the children's attitude toward visitors is .20 ±.11, which indicates that these children are less disturbed by visitors than one might think. Age appears to enter in, for when it is held constant the coefficient becomes −.03.

14. Six training methods were used; praise, favorable comparison, critical comment, timing, reward, and example. Surprisingly enough, the coefficients of correlation show very low relationships in case of praise, favorable comparison and reward, and low negative relationships with timing and example.

15. A table was prepared showing the influence of the various factors above in the case of the ten children who ate the highest average amount of food and the ten who ate the lowest average amount of calories. The results on this table checked with the correlations.

16. An analysis of the refusals of food, which were recorded as the attitude toward food only 2.23 per cent of the time, showed very little discrimination between vegetables, carbohydrates and protein food other than milk. The refusals of milk were the least frequent, and those of desserts the most often.

17. The attitude of "disliked but ate" was assumed most often toward vegetables and least often toward milk, the other foods ranging in between. This result gives some support to the opinion that children like vegetables the least of any food.

18. Correlations between the length of nursery school attendance and the attitudes toward food show a slight tendence on the part of the children to eat more "with relish," less as a matter of course, to assume the attitude of "disliked but ate" less, and to make fewer refusals of food the longer they are in the nursery school.

19. Since on the average in 95.8 per cent of the time the children are reported as liking their food, it seems safe to assume that this is the important factor in the kind of food eaten.

The nursery school environment where only those children who are, normal physically are permitted, where the meal is carefully balanced; the children's health is safeguarded, the equipment is suited to the child's size and needs, a fixed routine is maintained, causes for emotional disturbance are

reduced to the minimum, not too much but enough attention is given, and a happy, comradely atmosphere is maintained, may justly be assumed to have a large part in this wide-spread liking of food.

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A Study of Five Bilingual Children from the Same Family

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THE five children discussed in this study are a boy and four girls from the same family who lived part of their lives in China, where the four girls were born, and part in the United States, the country of their parents.

During their residence in China, they were exposed to two languages in their own home; English from their parents and Chinese from the servants. Their contacts with other children outside their home were mainly with other bilingual children of American or Canadian parentage, although there was a little contact with non-English speaking Chinese children. These bilingual children ordinarily used English as their medium of conversation. The formal education of the three older children who lived long enough in China for their schooling to be begun there was almost entirely in English. It is probably near the truth to estimate that their exposure to English and Chinese while in China was approximately equal until after three years of age when with increasing contact with other English-speaking children and the beginning of their formal education a few years later, English became more and more their preferred language. During their residence in the United States, however, practically no use was made of Chinese by either the children or their parents except for a few handy phrases.

One child, Ruth, was really monolingual until almost three years old as she spent the period from fourteen to thirty-four months in America. She thus serves to some extent as a control for the three children who were bilingual at that age.

The mother's records of the vocabularies of the four older children at twenty-one and twenty-four months as given in the table show that Ruth, the monoglot, used over twenty per cent more words at each age than did her brother, although, his mental ability as measured on the Stanford-Binet test at a later age was greater than hers. Ruth's vocabulary also was twice as large at twenty-one months and fifty per cent larger at two years than that of her older sister whose I.Q. is the same at a time when the two girls were equally bilingual. Lois, whose I.Q. exceeds Ruth's by ten points at nine years, however, equals her sister in size of vocabulary at two years. The distribution of these vocabularies between English and Chinese words are given in the table.

Jane, John and Lois were all exposed to the two languages during their second year. John, although born in

the United States spent the period from eleven months until seven-and-a-half years in China. Jane and Lois lived in China from birth until thirty-two and thirty-seven months old respectively and Jane returned to China, living there again from four years to ten-and-a-half years. John, owing to his mother's illness was cared for more by the Chinese nurse than were any of his sisters. This, probably, accounts for the higher percentage of Chinese words in his vocabulary.

During Jane's visit to the United States from thirty-two months to four years, she forgot much of her Chinese through disuse, though not so much as did Lois in the same length of time; owing to whooping cough and her mother's health (it will be remembered that her brother was born during this visit to America), Jane was confined pretty closely to home where her Chinese was understood; while Lois was sent to nursery school. That Jane's Chinese was not entirely forgotten is indicated in the Stanford-Binet test given her at three years eleven months when in response to the question, "What is a horse?" she answered, "Name *ma*," (the Chinese word for horse).

Lois had made a good start in talking before she left China just before her third birthday. Her vocabulary at two years was almost the same size as that of her monolingual sister and she seldom confused the two languages. But when she was enrolled in the Iowa Child Welfare Research Station's Preschool Laboratory at three years and three months, her mental age was only two years ten months and her vocabulary score was 960 words by the Smith Vocabulary Test. This was about four months below the norm for her age, when she was given that test at thirty-eight months. At three years five months, her vocabulary had increased to 1100 words which was equivalent to only about two months below her age level. And in the spring, at three years eleven months when her second language was completely forgotten, her mental age was four years giving her an I.Q. of 102 as compared with that of 87 in the fall. Five years later at nine years one month, in spite of a year of serious illness intervening which was due to complications from scarlet fever, Lois's I.Q. had continued to increase and was then 112.

Three of the four older children were tested at two or three years of age and again at nine or ten years. In every case the test used was the Stanford-Binet and a gain occurred in I. Q. In the case of Ruth, who on neither occasion was much affected by her knowledge of Chinese, the gain in I. Q. was but five points. Jane, who was still using a very little Chinese at the time of the first test and used English much oftener at the time of the second test, gained eight points. By the time of their second tests, these two girls, although able to use Chinese to a considerable extent, showed much greater facility with English and used it preferably whenever it would be understood. Lois, however, was still bilingual at the time of her first test, although she, too, was beginning to lose her former facility, and when she was nine years old she had completely forgotten her Chinese. She gained twenty-five points in I. Q. Apparently, the more truly bilingual the child was

at the earlier age, the more her I.Q. was affected.

The baby Mary had begun to talk and used quite a number of words, both Chinese and English (unfortunately the exact number is not available) at the time the family left China was still backward in talking, a sample of her conversation recorded at that time gave her a sentence length of but 1.7 words per sentence, which is the average for two year olds, showing a retardation of five months at that time although her I.Q. of 114 at seven

TABLE 1

Size of vocabulary and mental test scores of the five children

	JANE	RUTH	JOHN	LOIS	MARY
Birth order	1	2	3	4	5
Vocabulary at					
21 months (Norm 118 words)					
English words	45	121	41		19
Chinese words	16	3	61		1
Total	61	124	102		20
24 months (Norm 272 words)					
English words	122	250	83	164	
Chinese words	42	0	118	91	
Total	164	250	201	255	
Early mental test					
C. A. (years and months)	3–11	2–7		3–3	
M. A. (years and months)	3–8	2–6		2–10	
I.Q.	93	97		87	
Later mental test					
C. A. (years and months)	10–10	9–6	7–8	9–1	7–4
M. A. (years and months)	10–11	9–8	8–8	10–2	8–4
I.Q.	101	102	113	112	114
Gain in I.Q. of those tested twice	8	5		25	
Age of residence in China					
From	Birth	Birth	11 mos.	Birth	Birth
To	32 mos.	14 mos.	7 yrs. 5 mos.	35 mos.	15 mos.
And second residence					
From	4 years	34 mos.			
To	10 yrs. 7 mos.	9 yrs. 3 mos.			

when she was fifteen months old. By twenty-one months, all but one Chinese word had been dropped from her vocabulary and moreover, she was talking less and her English vocabulary had not increased by more than one or two words. At two years five months, she years would indicate a superior intelligence. This later retardation is due in part, however, to a mastoid operation at twenty-three months. The case of another child, similar to Mary's, has come to the writer's attention. Avis Ann, at nineteen months was

brought from a bilingual environment in China to Honolulu where the Chinese she had learned was not understood. She, too, ceased her progress in speech and even went backward for a time.

CONCLUSIONS

The cases of the two babies who were just beginning to talk at the time of change to an environment where a language they had used was not understood suggest that such a change causes enough mental confusion to a child, when he finds words that have heretofore produced results no longer do so, to cause him to tend to cease further attempts at speech for a time.

Lois's case of relatively low I.Q. and vocabulary at the time when she was adjusting to a similar change in environment with the later rise in both vocabulary and I.Q. as she forgot one of the two languages she spoke suggests that confusion arises from the use of two languages in preschool years.

The larger size of the vocabularies of the monolingual child, especially when the I.Q.'s of the children are taken into consideration, would also suggest a confusion in learning to talk on the part of the bilingual children. For norms referred to in this study see Madorah E. Smith (1).

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The Effect of Surroundings on Free Association in Young Children*

HELEN M. SUNDBERG

THE purpose of this study was to determine the effect of surroundings on free association responses made by young children. Much work has been done in the field of free association, but there is practically no experimental evidence concerning the effect of the immediate environment on results of such tests. The problem is an important one in the psychological field, especially in the experimental and testing divisions. Because of the emphasis placed on experiments of this nature in child welfare and child psychology, this study should be of value in further experimentation of this type.

The only experimental work which has much relationship with this study is that which has been done in connection with the naming sixty words test which is found in several of the standard individual intelligence scales. This test is located at ten years in the Stanford-Binet, and at eleven years in the Goddard and Kuhlmann tests. In his general procedure for giving this test, Terman uses the following instructions:

"Now, I want to see how many different words you can name in three minutes. When I say 'ready,' you must begin and name the words as fast as you can, and I will count them. Do you understand? Be sure to do your very best, and remember that just any words will do, like 'clouds,' 'day,' 'chair,' 'happy,'—Ready, go ahead." If there is a pause of more than fifteen seconds within the test, the child is urged with, "Go ahead, as fast as you can. Any words will do."

The test is passed if sixty words are named in three minutes. For the 10 year olds, Terman found the average number of words for the six successive half minutes to be: 18, 12½, 10½, 9, 8½, 7. He found that usually only the very intelligent improve after the first half minute. He also found that a large number of repetitions indicates a tendency to mental stereotypy. He states that the proportion of repetitions made by normal children rarely exceeds 2 or 3 per cent of the total number of words while retarded children of the same level often reach 6 or 8 per cent. There was a slight superiority of girls over boys shown throughout the entire scale from 5 to 13 years.

Terman (2, 3) found also that the per cent passing below I.Q. 96 was 30; those passing between I.Q. 96 and 105 were 70; while the per cent passing

* The writer gratefully acknowleges the advice and encouragement given her in the preparation of this study by Dr. Florence L. Goodenough.

above I.Q. 105 was 76. In discussing the types of response in relation to the testing room he writes,

"Another type of response consists in naming only objects present, or words which present objects immediately suggest. It is unfortunate that this occurs, since rooms in which testing is done vary so much with respect to furnishings. The subject who chooses this method is obviously handicapped if the room is relatively bare. One way to avoid this influence is to have all subjects name the words with eyes closed, but the distraction thus caused is sometimes rather disturbing. It is perhaps best for the present to adhere to the original procedure and to follow the rule of making tests in a room containing few furnishings in addition to the necessary table and chairs."

METHOD

Subjects

The subjects of this experiment were children attending the nursery school and kindergarten of the University of Minnesota Institute of Child Welfare. Records were obtained for 60 children, 30 boys and 30 girls, ranging in age from 2½ years through 5 years. Only three of the children were below 3 years at the time of their tests and in two of the cases this was only a matter of two and three months.

Experimental procedure

The best method of testing the effect of the surroundings on the responses of the children seemed to be to subject them at one experimental period to an environment containing a large number of external stimuli and at another time to place them in surroundings as free as possible from such stimuli. This was done by testing the subjects at one time in a room bare of all unecessary objects and then repeating the experiments in the same room containing a great number of articles. The room used was a rather small one, 11½ feet by 7 feet, lighted by a sky light in a sloping roof. The children could see only sky from the skylight, and so no outside visual distraction was present. A radiator below the skylight, a tier of shelves in one corner, an electric light, and two doors were also unremovable parts of the room. These, with the two chairs used by the experimenter and the subject and the recording apparatus, consisting of record blanks, pencil or pen, and stop watch, were necessarily present at all periods. The additional objects placed in the room at the crowded sittings were: a wagon, kiddie car, truck, small iron fire engine, wheel barrow holding a large wooden ball, folded cot, box with blanket on it, large basket holding some blocks, small hobby horse, large chair, and several books placed on one of the shelves.

The children were divided into two groups, each one paired with another according to sex, age, intelligence (I.Q.), and occupational status of the parents. In order to avoid the error that practise effect would have on the results, one group of the children was started in the empty room, while the other group was first tested in the crowded room.

Each experimental period was two minutes in length rather than the three minutes used by Terman. The three minute period seemed rather long for such young subjects and avoidance of fatigue was important. The responses were taken down sepa-

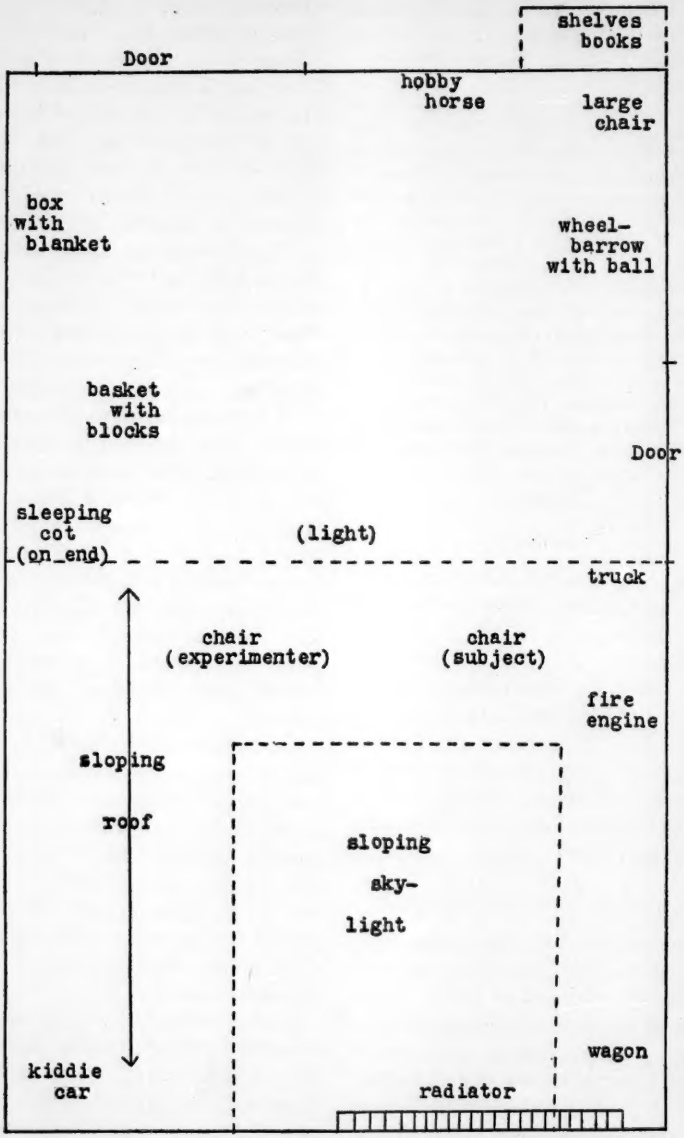

FIG. 1. SITUATION OF OBJECTS IN CROWDED ROOM

rately for each ½ minute and each subject was tested at four different periods within two weeks. Four succeeding days were used if this were possible but often absences or other experiments interferred. However, the cases were discarded where experimentation covered a longer period than two weeks. The children in group one were tested in the empty room for the first experimental period, in the crowded room for the second, then in the empty room once more, and finally were placed in the crowded situation again. For those in group two the same method was used except that their first experimental period was in the crowded room and their last in the empty one.

The name and the group number of each child was placed on each record blank, and the date, time at which the test was given, and the condition of the room (empty or crowded) was recorded for each of the four experimental periods. All of the responses of the subjects were taken down with the responses for each half minute divided into separate sections.

As each child came into the room a few moments were taken for conversation in which an attempt was made to establish "rapport" with the subject and to make him feel at ease. This was difficult in only a few cases as the experimenter was an assistant in the nursery school and was known to all of the younger children. The cases in which the child refused to respond were eliminated. The experimenter then said, "Tell me all of the things that you can think of. You can think of a door, can't you? You can think of a dog, and a light, and the sky, can't you? Now, can you tell me all the other things you can think of?" During the period in the crowded room the words wagon, grass, truck, and tree, were substituted for those used above. In both instances two of the objects named were in the room and two were outside associations.

At the first response the stop watch was started. If the child made no response, he was urged again, "You can think of many more things, can't you? Tell me all the other things you can think of." This urging was also used for pauses of longer than ten or fifteen seconds. If the child began repeating only the examples used by the experimenter, the latter said, "You can think of many other things too, can't you? Tell me all the other things you can think of."

At the end of each experimental period each child was given a small star which was pasted onto a small oblong piece of paper. This was in no sense a reward for good behavior as every subject was given one as a part of the general procedure and no mention was made of what had gone before. The intention was to keep up the children's interest throughout the four periods. This proved on the whole, very successful as the children were very proud of their stars and wished to keep repeating the experiment. A blue star was given at the end of the first experimental period, a red one at the end of the second, a silver one at the end of the third, and a gold one at the end of the fourth period.

No child was given the test more than once on one day. Most of the children were tested during the hours from 9:30 to 11:00 in the morning. The

exceptions to this were the children of the afternoon kindergarten session who were tested from 1:30 to 2:30. These hours appeared to be the best for the experimental work as at those times the children are usually feeling at their best.

RESULTS

Treatment of data

The words given by each of the subjects during the four experimental periods (I–E, II–E, I–C, and II–C were totaled both for the half minutes and for the entire two minutes. The lists were then looked over and the responses totaled excluding all repetitions. Then the number of words of outside associations were recorded both with and without repetitions. From the list of outside associations all words which were specifically connected with the experimental situation or procedure were omitted. Thus none of the words which had been used as examples by the experimenter were counted. Likewise such things named as articles of clothing worn by the experimenter or subject were excluded.

The totals under all these conditions were then averaged so that the mean score (number of words) might be obtained for the four experimental periods. This same procedure was followed for each of the half minute periods also. The sixty subjects were then divided into three groups according to age, 3 year olds, 4 year olds, and 5 year olds. The three children who lacked a few months of being three years were included with this group. The 3 year olds consisted of the children ranging in age from 2 years, 10 months to 3 years, 10 months; the 4 year olds ranged from 3 years, 10 months to 4 years, 10 months; and the 5 year olds covered from 4 years, 10 months to 5 years, 10 months.

TABLE 1

Age distribution of subjects

	3 YEARS	4 YEARS	5 YEARS	WHOLE GROUP
Girls	6	8	16	30
Boys	5	9	16	30
Total	11	17	32	60
Mean age in months	37.45	52.53	64.87	56.32

TABLE 2

Reliability coefficients

CORRELATIONS BETWEEN:	r	P.E.	r RAISED BY SPEARMAN-BROWN FORMULA
I–E and II–E, all words included	.59	.056	.74
I–C and II–C, all words included	.78	.0341	.88
I–E and II–E, repetitions excluded	.68	.0468	.81
I–C and II–C, repetitions excluded	.75	.038	.86

Table 1 shows the distribution of subjects according to age and sex and the mean age of the whole group and for each age group.

The half minute totals for these age groups were then recorded and averaged. Groups averages for the second, third, and fourth half minutes were expressed as percentages of the first half minute for the four experimental periods.

Reliability

The totaled scores for all the children for I–E (first experimental period in empty room) were then correlated with the total scores of II–E, and the same was done for the I–C scores (first time in crowded room) and the II–C scores (second time in crowded room). Correlations were also figured for I–E and II–E without repetitions, and I–C and II–C without repetitions. The results are shown in table 2.

The correlations between the crowded situations, both with and without repetitions, are a good bit higher than those between the empty situations. This is especially interesting considering that Terman advises as bare a room as possible for the sixty word test. Another interesting point is that in the case of the empty room the correlation is raised by excluding repetitions whereas in the crowded situation it is lowered by 3 points by this exclusion. It might have been expected that the correlations between scores with repetitions excluded would be higher in both cases. The fact that the differences are reversed between these two sets of correlations may be due to chance.

The reliability of the difference between the coefficients for the empty and crowded situations were determined. The results obtained with and without repetitions were .066 and .06 respectively. When the obtained differences between the two correlations were divided by the probable error of the difference, in both instances the results were 2.88 when all words were used and 1.17 when repetitions were excluded. Therefore, when all words are included, there were 97.5 chances in 100 that the true difference in favor of the crowded room is greater than zero; when repetitions are excluded, there are only 78.4 chances in 100 that the difference favoring the crowded room is greater than zero.

TABLE 3

Average number of associations

	I–E		II–E		I–C		II–C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Total words	17.68	8.54	22.27	8.44	20.30	8.28	24.20	9.38
Without repetitions	15.98	7.94	21.05	7.64	19.75	7.81	20.97	8.46
Total outside associations	9.0		11.17		6.45		8.25	
Without repetitions	8.57		10.18		6.1		7.53	

In correlating the combined scores for the empty situation with the combined scores for the crowded situation the results obtained were:

	r	P.E.
E and C with all words included	.63	.0525
E and C without repetitions	.89	.0180

The first correlation .63 is rather low but when repetitions are excluded the higher r of .89 is obtained. This indicates that the individual children tend to hold their place much better in the two situations when repetitions are excluded.

General averages

Table 3 shows the average number of words for the whole group of sixty children for the four experimental periods.

As will be noted in a comparison of the averages of all words and the averages without repetitions, the second crowded period is the only one in which more than two words are repeated. In this there were 3.23 repetitions. This is an interestng point, for, considering the youth of the subjects, more repetitions might have been expected. In the averages of outside associations the mean number of repeated words is never greater than one.

TABLE 4

Per cent of repetitions

	I–E	II–E	I–C	II–C
	per cent	*per cent*	*per cent*	*per cent*
Total words	8.4	5.4	2.7	13.3
Outside associations	4.8	8.8	5.4	8.7

The proportion of repetitions to total number of words as shown by per cents is greater in most cases than that given by Terman for normal children. He found 2 or 3 per cent repeated words in normal children while 6 or 8 per cent were given by retarded children. Table 4 shows the per cents found in this study. The higher per cents seem natural since the subjects were so much younger than those used by Terman.

On the average the fewest number of words were given in the first empty period and the greatest number in the second crowded situation. More words were given in the second empty situation, however, than were given in the first crowded situation. In the averages excluding repetitions the second crowded period loses its lead to the second empty period. This, however is not significant as the difference is only .08 of a word. Fewer outside associations were given in the crowded room than in the empty one. In both instances in the crowded room, with and without repetitions, the mean number of outside associations was less than in the first empty period. The greatest number of outside associations were given in the second empty period. It is natural that there were more outside associations in the empty room because the child had fewer inside stimuli on which to draw.

TABLE 5

Scores by half minute intervals

		FOUR SUCCESSIVE HALF MINUTES			
		1	2	3	4
Whole group averages	I–E	6.13	4.03	3.56	3.95
	II–E	7.25	5.42	4.78	4.68
	I–C	6.68	5.05	4.22	4.35
	II–C	8.53	5.77	5.07	4.50

The results for the four successive half minutes of the four experimental periods can be seen in table 5, and a comparison with the results found by Terman for his 10 year olds is given in table 6.

The average number of words given by Terman's subjects is, naturally, greater than the average found in this study. The per cents, however, do not differ radically, especially for the second and third half minutes and in the fourth half minute the children of this study hold up somewhat better

than did Terman's. Terman finds a decrease in per cent for each successive half minute. On the whole the same tendency is found in this study. However, a few exceptions may be noted here. An increase in the average number of words is found in the last half minute in two cases out of four (I–E and I–C) and the whole group (table 5); in three cases out of four (I–E, I–C, and II–C) for the five year olds (table 7); and in three cases out of four (I–E, II–E, and I–C) for the four year olds. In the three year old group there is a decrease in the last half minute in all cases except I–C where the average number of words is the same as in the third half minute. In I–E and II–E, however, the average of the third half minute is larger than that of the second half minute.

TABLE 6

Comparison with Terman's results

		SUCCESSIVE HALF MINUTE					
		1	2	3	4	5	6
		Average number of words for Terman's 10 year olds					
		18	12½	10½	9	8	7
Per cent of first half minute	Terman's	100	69.4	58.3	50	47.2	38.9
	I–E	100	66	58	64		
	I–C	100	76	63	65		

Correlation with I.Q.

The scores for the crowded room and those for the empty room were correlated with the I.Q.'s received by the children when tested with the Minnesota Intelligence Test. The results were as follows:

	r	P.E.
C scores and I.Q.....	.14	.087
E scores and I.Q.....	.10	.088

These correlations are so low that they probably come within the limits of chance. As will be noted the probable errors are very large.

Sex differences

In comparing the mean number of words given by the thirty boys and the thirty girls in the four different periods for all words, with and without repetitions, and for outside associations with and without repetitions, the boys averaged fewer words in 8 of the cases, were even with the girls in 4, and averaged slightly higher in all of the results obtained in the II–E period. Table 8 shows these results. Most of the differences shown in the table are very small and probably insignificant. The largest is found in II–C for all words where the girls average 3.76 words more than the boys. This is evened up, however, when repetitions are excluded. To draw conclusions from data with so few cases is hazardous, but the results are at least suggestive and may mean that the girls are more talkative at the outset but that the boys have more associations and get larger scores in the second experimental periods when their inhibitions are reduced.

Occupational status

The nursery school and kindergarten children are placed in groups from I to V according to the occupation of the father. There are no cases in group VI, which consists of unskilled laborers. Members of group I are professional people and the others range down to the laborers. For purposes of comparison, the children in this study were placed in two groups, the first including the subjects who belonged in groups I and II, and the second those who belonged in groups III, IV, and V. In all cases the mean number of words given by those in III, IV, and V was less than the average number for those in I and II, either with or without repetitions. The greatest difference was a superiority of

TABLE 7

Scores by half minute intervals and by age

		FOUR SUCCESSIVE HALF MINUTES			
		1	2	3	4
5 year olds averages	I–E	7.31	5.06	4.41	5.19
	II–E	8.44	6.75	5.66	5.59
	I–C	7.91	5.91	5.25	5.38
	II–C	10.09	6.66	6.06	6.53
4 year olds averages	I–E	5.82	3.76	3.18	3.41
	II–E	6.59	4.71	4.35	4.59
	I–C	6.35	4.65	3.24	3.47
	II–C	7.76	6.00	5.12	4.12
3 year olds averages	I–E	3.18	1.45	1.73	1.09
	II–E	4.82	2.64	2.91	2.18
	I–C	3.64	3.18	2.73	2.73
	II–C	5.18	2.82	2.09	1.91

TABLE 8

Averages according to sex

		I–E	II–E	I–C	II–C
Averages of total words	Girls	18.69	22.72	21.24	25.21
	Boys	17.90	23.34	20.76	21.45
Average without repetitions	Girls	18.10	20.24	20.10	22.66
	Boys	16.59	21.55	19.38	22.76
Outside associations	Girls	9.69	10.45	6.66	8.48
	Boys	8.97	12.62	6.72	8.55
Outside associations without repetitions	Girls	9.38	9.48	6.45	7.69
	Boys	8.38	11.59	6.17	7.86

2.47 words for those in I and II in the II–C situation. When repetitions were excluded this became 3.43 words. In the I–C situation when only outside associations were counted, the lower group had a slightly higher score. In the other averages of outside associations with and without repetitions, those in groups I and II had a higher average. The occupational class differences may be seen in table 9. Although these differences are small, the fact that they are found in all of the conditions is significant.

TABLE 9

Averages according to occupational class

	OCCUPATIONAL CLASS	I–E	II–E	I–C	II–C
Averages of total words	I and II	18.56	23.07	20.78	25.56
	III, IV and V	17.00	22.22	19.91	23.09
Average without repetitions	I and II	17.81	20.67	19.85	23.85
	III, IV and V	15.88	19.70	18.48	20.42
Outside associations	I and II	9.93	12.03	6.11	8.56
	III, IV and V	8.24	10.42	6.76	8.00
Outside associations without repetitions	I and II	9.59	11.37	5.85	8.11
	III, IV and V	7.73	9.21	6.30	7.06

Correlations with other traits

Twenty-nine of the subjects of this experiment had been members of the nursery school the preceding fall when an observational study was made on a number of traits. A description of the method used in this study will be found in an article by Florence L. Goodenough (1). Data taken from this experiment made possible correlations between the combined scores for both the empty and crowded room and results found in the study of talkativeness, nursery school attendance, Marston ratings for extroversion and introversion, and chronological age. These correlations are shown in table 10.

The correlations for both the crowded and empty averages and the Marston ratings are so low that they come within the limits of chance. This is also true of the correlations with the talkativeness scores. At any rate

TABLE 10

Interrelations between E and C scores an other traits

	r	P.E.
E scores and Marston scores.	.14	.1230
C scores and Marston scores.	.06	.1250
E scores and talkativeness...	−.04	.1254
C scores and talkativeness...	.22	.1194
E scores and C. A.....	.60	.0803
C scores and C. A.....	.78	.0491
E scores and N. S. attendance.	.64	.0740
C scores and N. S. attendance.	.42	.1033
N. S. attendance and C. A...	.80	.0452
E scores and N. S. attendance (C. A. partialled out).....	.33	.1097
C scores and N. S. attendance (C. A. partialled out).....	−.54	.0879

the probable errors are too large to make the correlations reliable.

The correlations with C.A. show, as would be expected, a positive relationship and indicate that the older children give more words, on the average, than the younger children. A correlation of .60 with the scores for the empty room and of .78 for the crowded averages indicates a tendency for the older children to name more words in the C situation than in the E room. The older children perhaps pay more attention to the articles about them than the younger ones. The total scores for the empty and the total scores for the crowded situation show correlations with nursery school attendance of .64 and .42 respectively. When C.A. is partialled out the correlations become .33 and −.54 respectively. This might indicate that the children who have attended the nursery school longest have a tendency to make less use of observation of articles in the crowded situation. However, since the cases are few, the probable errors are high; and so, on the whole, these correlations do not have great significance.

SUMMARY

Free association tests given to preschool children in an empty and a crowded room gave results as follows:

1. Higher reliability coefficients were obtained for tests given in the crowded room; in other words the crowded situation had a more constant effect on the scores made by these children, an interesting point in view of the fact that Terman advises as bare a room as possible for his "naming sixty words" test.

2. Correlations between the empty and crowded situations yielded a coefficient of .63 when all words were considered and one of .89 when repetitions were excluded.

3. These children gave fewer words in each half minute than did Terman's 10-year-olds, and there was a tendency for the percentage of words to decrease in successive half-minute periods, a finding which is also in agreement with Terman's.

4. In all but one case repetitions averaged less than 2 words, but the percentage of repetitions were greater than those found by Terman.

5. Fewer outside associations were given in the crowded room than in the empty room.

6. Correlations with I.Q. were .14 for the crowded and .10 for the empty room.

7. Sex differences were small, in most cases favoring the girls. The boys scores improved in the second experimental period when they were familiar with the situation; and the difference favoring the girls was less when repetitions were counted out. This suggests that girls are more talkative while boys have more associations.

8. Throughout there were small but consistent differences between children from occupational classes I and II and those from classes III, IV and V; children whose parents belong to the higher occupational classes had more association.

9. Data were available on other traits for 29 out of the 60 subjects. Correlations of the combined C and E association scores with Marston ratings and with ratings on talkativeness

gave coefficients so low as to come within the limits of chance.

10. Correlations of .62 and .42 were obtained between nursery school attendance and E and C scores respectively; these became .33 and −.54 when C. A. was partialled out.

11. Correlations between associations and C. A. were .60 for E scores and .78 for C scores.

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Learning of Children in Adaptation to Mirror Reversals

EUGENIA KETTERLINUS

THE mirror drawing experiment has been considered of special importance for the study of the trial and error method of learning by adults. The assumption has been made that few habits have been established of hand and eye coordinations under conditions that require the observation of movements in the mirror. Especially is this true of the child under six years of age, who ordinarily makes few motor adaptations to objects seen only in a mirror. The analysis of the learning process of the child under such conditions is the problem of this investigation.

An historical survey of the literature on this problem, namely, the adaptation of the preschool child to the mirror situation, cannot be made, as no work has been published to date on the reaction of young children to mirrored presentations. The nearest approach to work with preschool children is that of Clinton (4) who continued the work of Pyle (11) with fourth to eighth grade children, down to third, second, and even first grade children. A brief review of mirror drawing as a psychological experiment is given.

Mirror drawing, as a bona fide psychological experiment, makes its first appearance in print in Henri's (7) monograph, *Ueber die Raumwahrnehmungen des Tastsinnes*, published in 1898. In this book, dealing with tactual space perception, only a page and a half is given to the mirror drawing experiment, which is simple in character but has all the essential elements of the later more elaborate set-ups. No data are given as to the number of subjects who tried this experiment, nor the number of trials they were given.

Henri (8) goes more into detail about the mirror drawing experiment in his article *Revue général sur le sens musculaire*, which differs somewhat from the original experiment. Instead of two points to be joined by a straight line, he used a straight line, drawn at an angle of 45° at the right of the paper, and asked his subjects to draw lines parallel to the model line. He had two subjects besides himself, and all three of them had considerable difficulty in drawing straight lines. Henri did not keep time but recorded the number of trials necessary before a good copy was made. He reports that in one case 200 repetitions were necessary before a straight line was achieved.

In 1905, Dearborn (6) used the six pointed star as the figure to be traced in his mirror-drawing experiment, but he did not publish a description of it until 1910. Dearborn considered the use of mirror-drawing as valuable in giving the student an opportunity for

first hand experience with the trial and error method of learning. He says: "There is some advantage in an experiment which will indicate that the trial and error method is, in certain conditions, regularly employed in adult human learning. The student is apt to get the impression from the usual discussion that trial and error, as a method of learning, is confined to animals and children."

In 1907–08 (not published until 1910), Burt (2) gave a series of tests, intended to test general intelligence, to a group of elementary school boys and to a group of preparatory school boys. Among these tests was one using a mirror. Burt gives credit for the idea of using a mirror to Mr. Keatinge but says he, himself, devised the test as used. This test differs from any used before in that there is no actual drawing. The set-up, aside from the mirror and screen, consisted of a thick cloth laid upon a firm table; on the cloth was placed a sheet of paper and upon the paper was pinned a sheet of stout millboard pierced with eight holes arranged in the form of a circle 20 cm. in diameter, with a ninth hole in the center. The reactor was required, using a blunt mounted needle to punch through the holes in the cardboard, thus leaving a pattern in the paper beneath. The holes had to be punched in a certain order, and the time taken to punch all the holes was kept. For the elementary school boys, Burt reports a correlation between this test and estimated intelligence of 0.67, P.E. .07; for the preparatory school boys a correlation of 0.54, P.E. .14.

In 1910, Starch (13) used mirror-drawing for his experiment in cross-education. He used Dearborn's set-up and six pointed star. His procedure was to trace one star with his left hand and then he traced 100 stars with his right, tracing only one a day. Then he traced one star with his left hand. His right hand improved 92 per cent in accuracy and 84 per cent in speed, his left hand improved between the first and second trials 81 per cent in accuracy and 85 per cent in speed.

D. S. Hill (9) used the mirror-drawing experiment with thirty elementary and thirteen preparatory school boys and reported the experiment very satisfactory to illustrate the learning process.

On December 8, 1913, Hill (10) had one of the same subjects whom he had used in the above experiment repeat that experiment in order to see how much relearning would be necessary. This subject had had his last trial in mirror-drawing on December 20, 1910, when his time had been 24 seconds. On December 8, 1913, after an interval of nearly three years, his time on the first trial was 36 seconds. His original first trial had been 107 seconds. Hill concludes from this that there is very little trial and error learning after the first few trials.

Inappropriate as it may seem, it is the work of Weidensall (14) on *The Mentality of the Criminal Woman* which was a real contribution to make toward the understanding of the reactions of certain children in the preschool group used in this investigation. Dr. Weidensall says that the mirror-drawing test served better than any other used at Bedford to isolate the

women who were incapable of sustained effort or emotional control, and certainly the behavior of some of my small subjects suggests that the mirror situation is an excellent one for revealing emotional instability.

Dr. Weidensall gave the mirror-drawing test to 69 of the Bedford Reformatory women, 16 college maids, and 36 college students. The instructions were the same as given by Whipple (16). In both first and last stars (5 in all), both as to time and errors, the three groups are consistently arranged in the same order with respect to percentile records, average and limiting scores. The students have the fewest errors and quickest time, the maids are intermediate and the reformatory women have the slowest time and greatest number of errors.

"The test isolates" says Dr. Weidensall, "the extremely low grade feeble minded, who, no matter how hard they try, cannot succeed in tracing a precise star. The epileptics have a characteristically bad time and their stars are all knotted up with 'blind spots' where they are caught and held indefinitely. . . . . Chiefly however, is the test of interest in the case of those who are clever enough but too unstable to trace the star well. These are invariably the girls who are difficult to manage in the institution. The tracing goes well enough until suddenly, at a hard point, the pencil starts, and persists upon going, in the wrong direction. The subject then tugs and pulls, grows more and more irritated, disturbed and excited, makes big black circles and unprofitable markings, soon loses all control of herself, and finally throws down the pencil and gives up. . . . . No other test has so conspicuously precipitated this state of instability on the part of the more excitable inmates, who work well as long as they meet with easy success, but who have not reserve force or stability in the fact of a difficult situation which demands of them patience and perseverance."

Cooke (5) also has something to say regarding the diagnostic possibilities of mirror-drawing experiments. He gave the star to a group of high school boys and reports that: "As a personal study this test was very interesting, showing traits of nervousness, carefulness, persistency, and lack of concentration."

In 1918 a description of a new apparatus is given by G. R. Wells (15) which has the advantage of automatically counting the errors made. This device consists of a small brass star inside of a larger brass star with a cement path between the outer edge of the small star and the inner edge of the large star. The cement is flush with the top of the stars. The subject is to trace the cement path with a stylus, which is hooked up to a recording device, so that when it gets off the path onto the brass that error is recorded. This apparatus has the disadvantage of giving no permanent record of how far off the path the subject wanders.

An exhaustive study of tracing the six-pointed star, by G. S. Snoddy (12), was published in 1920. The apparatus used was something on the order of the one described by Wells (15), a brass star being used on glass. Snoddy had 21 subjects, 9 graduate students used for objective data and introspection, and 12 advanced students for objective data only. The most interesting data in this investigation from our point of view are the introspections, which are suggestive. As they are very long, only one will be quoted. A

representative one seems to be Observer 3, who, on the first day of his practice had this to say:

"As soon as I heard the signal, I proceeded to follow the arrow. Then my stylus struck the niche up on the first side. I did not know I was moving in that direction until I struck the side; I tried to push away but found I was pushing against the side. I attempted two or three times to get away but could not; I thought the electric current must be holding the stylus against the sides; I was aware of intensive strains in my arm and the whole affair was very unpleasant. Finally, I gave up and relaxed for a time. I again looked at the star and found that my stylus had moved partly out of the niche during my relaxation. I attempted to get away but drove the stylus back into the niche again. Then the muscles of my arm and shoulder tightened and, with a quick movement, I pulled the stylus out of the niche and down past the arrow."

For a less extended historical survey, read Carmichel (3), and since his article appeared we have the interesting work of Bray (1) and of Clinton (4) published in 1928 and 1930 respectively. Bray's investigation is a combination mirror-experiment and accuracy-experiment, devised to study transfer of learning from hand to foot. The procedure was the same for both the hand and foot experiments. In the hand experiments, the subject sat at a table placed against a wall; on the wall was a target consisting of a cross drawn on a sheet of white paper (in later experiments the cross was changed to a simple vertical line bisecting the paper), which could be seen only by means of a mirror placed on the left. The subject placed his arm under the screen on a marked spot, directly in front of the center of the cross. In his hand was a pencil, with which he was told to hit the cross in time to a metronome beating at 72 per minute. Each subject was given 10 hits, then a rest period of 2 minutes, and then began again with a new target. Each 10 hits was called 1 trial, and 10 trials were given a day. In the foot experiment, the subject sat in an elevated chair with his thigh in a rest. This rest was directly in front of the target, so that the foot hung in front of the mark. A group of 14 subjects were given 60 trials with the right hand and then 40 trials with the right foot. A second group of 14 subjects were given only 40 trials with the right foot only. The group which had had the hand practice showed increased initial accuracy with the foot. Other similar experiments were made and a transfer of learning from right hand to right foot was shown.

Clinton used a pattern having the numbers 1 to 24 inclusive, arranged in two circles. Numbers 2, 5, 8, 11, 14, 17, 20, and 23 made up the small inner circle, and numbers 1, 3, 4, 6, 7, 9, 10, 12, 13, 15, 16, 18, 19, 21, 22, and 24 made up the large outer circle. A small dot located at each numbered point of these circles was to be cut by a continuous line from 1 to 24. Each subject's score was the number of lines completed during a five minute period, and if a whole pattern was completed within the time limit, a second sheet was given. For grades 1, 2, and 3, a pattern sheet was designed with numbers from 1 to 15.

The data were obtained from 1903 unselected students in four school systems, consisting of one group of ele-

mentary school students, two groups of high school students and two groups of university students in educational psychology. Clinton finds practically no relation between mirror-drawing ability and general intelligence as measured by I.Q.'s. The most interesting feature of Clinton's work is the indication that age is an extremely important factor in mirror-drawing ability. He has averaged the scores in each year from six to seventeen, for boys and girls separately, and finds a definite improvement in the score at each age, except that the 12 year old boys did not do quite as well as the 11 year old boys.

APPARATUS AND PROCEDURE

Three forms of procedure were used, graded from a simple to a difficult performance. This grading was conjectural but based upon experience with children between the ages of one and a half to six years of age, and upon knowledge of their abilities as measured in other test situations. It was known that they could not trace a star, nor even a straight line accurately, in direct vision.

The subjects were children in the Child Institute of the Johns Hopkins University, ranging in age, at the time of the beginning of the experiment, from two years and one month to five years and four months. Only one child was over five, the next younger being four years and seven months. There were 19 boys and 8 girls.

Twenty-eight children started this experiment, only one child did not complete it. This one child left school after the second week of the experiment, because of illness and did not return. Of the 27 children who completed the experiment, twelve were below three years of age, six were below four years of age, eight were below five years of age, and one was over five.

The apparatus for each form of procedure will be described in the section giving the experimental results for that form.

PROBLEM I

A mirror, 30 by 25 centimeters, hung between two uprights so as to permit adjustment at various angles, was placed at the back of a table 51 centimeters high and 43 centimeters square. In front of the mirror was placed the board, 36 centimeters wide and 33 centimeters deep, containing the test objects. On the extreme left of this board, and midway from the front to the back, a tin cup 6.5 centimeters in diameter and 5 centimeters in height was screwed. The outline of the three objects was drawn on the board so that they could be replaced in exactly the same positions. These objects were a spoon, 5.5 centimeters in length, placed 28 centimeters from the front edge of the board and 18 centimeters from the right hand edge; a white pearl button 2 centimeters in diamenter placed 20 centimeters from the front edge of the board and 8 centimeters from the right edge; and a ball 2 centimeters in diameter, made of clay with one side flattened so that it would not roll, placed 9 centimeters from the front and 20 centimeters from the right. A cross was made at the front of the board 7 centimeters from the right edge. This board, with the objects in position, was placed on the table with its front edge flush with the

front edge of the table. For a screen to cut off direct vision, a piece of thin board was used, as being more substantial than the usual cardboard, in anticipation of the children leaning on it and trying to look under. This board was 38 by 25 centimeters and had a strip of light wood nailed to it and extending beyond it 10 centimeters, which was clamped into an ordinary adjustable laboratory support fastened to the right of the table.

The first time that the child was brought in to "play the game," the mirror was on another table and the screen swung around to the right out of the way, so that the board with the cup and three objects was in plain sight. This was for the control test, each child being given one trial with direct vision so that the time normally required by the child to complete the task would be known and could be used to check the amount of slowing up caused by the mirror reversal. The child was seated in a chair, its seat 35.5 centimeters from the floor, which was then moved up close to the table. The observer then took the child's right hand, placed it on the cross marked on the board, and held it there, saying:

"See the things on the table, when I say 'Go' you are to pick up the ball and put it in the cup, then pick up the button and put it in the cup, and then the spoon, as quickly as you can. Understand? You are to pick up the ball and put it in the cup, then the button, and then the spoon.

Get ready—Go—Put the ball in the cup."

If necessary, that is, if the child hesitated after the ball was put in the cup, the observer prompted with "Now the button" or "Now the spoon" or both, as the occasion required. Time was kept with a stop watch from the release of the child's hand at "Go" to the sound of the spoon hitting the bottom of the cup.

Then the child and chair were pushed back, the child being allowed to get up if he wanted to. The observer swung the screen around into position, replaced the objects on the board, put the mirror on the experimenting table and moved the child up to the table again, saying,

"I want you to do exactly what you did before, first put the ball in the cup, then the button in the cup and then the spoon, but now you cannot see them except in the mirror, which makes things look differently, and you will have to watch where your hand goes in the mirror so that you can pick them up and put them in the cup. Can you see the ball and the button and the spoon and the cup?" If the child said "No," the mirror was adjusted until he could see all four. Then the observer placed the child's right hand on the cross and asked if he could see that, too. Then the observer said, "When I say 'Go' do just what you did before, pick up the ball and put it in the cup, then the button and then the spoon. Ready,—go."

As before, the observer prompts as to which object is to be sought next. Time was kept from the release of the child's hand to the tinkle of the first object as it landed in the cup; from that second until the next object was dropped into the cup; and from the placing of this object until the sound of the final object hitting the bottom of the cup. Time was the only score used because, as there was no record of the child's movements made, no accurate count could be made of errors; but after each trial, the observer wrote down anything unusual that occurred, such as the child's dropping an object,

or knocking it off the board, or changing from one hand to another, or persistently overreaching, etc.

Two trials were given each day, the second trial immediately after the first. After the objects were replaced, the observer said, "You did that very nicely, now see if you can do it even better this time. Do just what you did before." The trials were given in

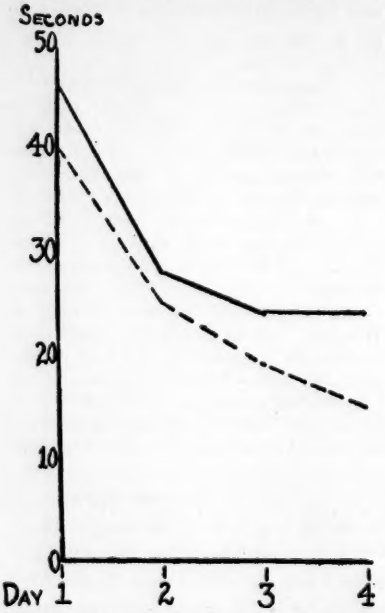


FIG. 1. MEAN TIME, FOR PUTTING OBJECTS IN CUP

——— first trial;---------- second trial

a series of four days, one week apart. This schedule of one week apart was adhered to as nearly as absences and holidays would permit, and in the majority of cases was carried out exactly.

Results

The first experiment shows conclusively that four, three, and even two year old children can learn to inhibit established habits and can rapidly acquire new ones. The mean score for all three age groups combined shows a definite improvement, not only from day to day, but also of the second trial over the first (see fig. 1). Taking the age groups separately, we find a somewhat different picture, although the final result is the same, that is, the final mean score for each group is the lowest mean score for that group. The four year old group shows the fewest irregularities, which might be expected on the basis of their comparative ma-

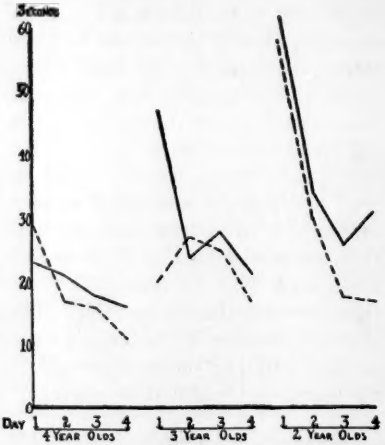


FIG. 2. COMPARISON OF THREE AGE GROUPS

——— first trial;---------- second trial

turity, but the three year old group shows more irregularities than does the two year old group, which may be due to the influence of individual differences because of the few subjects in this group. (See fig. 2).

The mean scores of the four year old group show an improvement on each successive day, but on the first day the second trial is a decided slump over

the first, due to subject Dl's getting badly "lost" trying to reach the spoon, and subject F having a similar difficulty with the button.

In the three year old group there is a slight regression in the first trial on the third day, and the second trial on the second day is not only worse than the second trial on the first day but is inferior to the first trial on the same day. The second trial improves slightly on the third day but not up to the standard set by the second trial on the first day. The vagaries of the second trial on the second and third days are due to one subject, I, who got stuck on the ball on the second day and the spoon on the third day. The explanation of the slowing up of the first trial on the third day is that three subjects, I, L, and Ll, slowed down on their time for putting each object into the cup.

The two year old group shows a consistent improvement from day to day on the second trial and on the first trial with the exception that the fourth day's score is five seconds slower than the third day's score.

All the mean scores referred to above are for the complete test, that is, the time required to put all three objects into the cup. The time for putting each object into the cup was kept for two purposes, first, in order to show up wide fluctuations in scores, for which it has proved invaluable, and second, on the theory that one position on the board might offer greater difficulties than another. This latter idea is not supported by the facts, for a careful scrutiny of the mean scores for specific objects in all three age groups combined shows no particular differences in their relative difficulty, therefore all scores mentioned, unless otherwise specified, will refer to the time required to complete the test.

Although there are decided individual differences shown they are not as great as were anticipated. The subjects who got "lost" once, tended to do so again. In all three groups there is not one case in which a subject gets "lost" after the second day, unless he has been "lost" earlier, and only one case in which the first trouble of this kind appears on the second day. On the other hand those subjects who got lost on the first day, in spite of marked improvement, might suddenly get badly stuck on one object even on the fourth day.

Four year old group. The shortest time on the first trial in the four year group was made by subject C, four years and five months old. This time was 9 seconds and he also made the shortest final trial, time 6 seconds. (See table 1.) It is interesting that 6 seconds is also his time without the mirror. This subject is the only one who brought his mirror time down to his time without the mirror, although a number of others reduced their time to within a few seconds of their direct vision time.

The longest first trial in the four year group was made by subject B, aged four years seven months. Her time was 50 seconds, twenty-nine of which were spent trying to locate the button. On the final trial she had reduced her total time to 17 seconds. For a comparison of her complete performance with that of subject C consult figure 3. The longest time taken by any child in the four year group was in the second trial on the first day by subject Dl who took 66 seconds. He

TABLE 1

SUBJECTS	1ST DAY		2ND DAY		3RD DAY		4TH DAY		TIME WITHOUT MIRROR
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	
Four year old group—time in seconds									
A	23	20	42	20	25	35	20	14	8
B	50	31	22	17	22	22	42	17	6
C	9	12	12	19	18	11	11	6	6
D	17	25	22	15	15	15	11	9	6
D1	13	66	18	15	15	10	13	9	6
E	35	30	33	22	30	16	19	13	9
F	26	56	17	18	17	13	15	9	8
G	18	9	12	18	10	14	8	7	5
H	20	15	18	9	12	11	10	12	5
Totals...	211	264	196	153	164	147	149	96	61
Mean....	23.4	29.3	21.7	17.0	18.2	16.3	16.5	10.6	6.7
Three year old group—time in seconds									
I	54	55	45	79	56	77	32	23	11
J	22	18	13	10	12	12	11	10	5
K	43	9	25	23	14	10	22	27	7
L	120	18	21	21	30	14	19	14	7
L1	17	13	20	15	40	20	16	13	7
M	29	12	19	17	16	22	27	20	11
Totals...	285	122	143	165	168	155	127	107	48
Mean....	47.5	20.3	23.8	27.5	28.0	25.8	21.1	17.8	8.0
Two year old group—time in seconds									
N	51	28	10	18	39	15	11	12	9
N1	24	23	64	29	46	23	64	21	6
O	20	20	25	15	20	26	20	10	9
P	35	13	21	25	34	20	20	23	7
Q	21	30	37	24	22	11	28	13	9
R	179	183	43	45	27	17	82	25	10
S	25	13	30	16	20	14	24	13	12
T	122	81	19	18	28	18	21	15	8
U	40	27	20	35	16	10	15	13	10
V	80	222	117	78	18	37	20	15	14
W	37	21	22	32	20	18	25	10	9
X	118	43	20	30	30	18	49	35	17
Totals...	752	704	428	365	320	227	379	205	120
Mean....	62.6	58.6	34.0	30.4	26.6	18.3	31.5	17.0	10.0

reduced his time on the final trial to 9 seconds, his time without the mirror was 6 seconds.

Of the nine subjects in the oldest group, eight made their best score in the final trial, and one subject made his best time in the second trial of the second day. This was subject H, the youngest child in this group. He did remarkably well throughout the experiment, his highest score, which was on the first trial on the first day was 20 seconds and his final score 12 seconds.

Three year old group. The shortest first score in the three year group was made by subject Ll, three years and seven months old. (See table 1). Her time was 17 seconds, which is considerably slower than the best first score in the four year group. Subject Ll did not make the best final score by four seconds, and her final score, 13, she had equalled on her second trial on the first day. Her time without the mirror was 7 seconds.

The longest first score in the three year group was made by subject L, aged three years and eight months, time 120 seconds, more than twice the longest first score in the four year group. This is the longest time on any trial in this whole group. She reduced her time in the second trial on the third day and in the final trial to 14 seconds, her time with direct vision was seven seconds.

The most consistent good record in the three year group was made by subject J, aged three years and eleven months. His highest score in the whole series being 22 seconds, made in the initial trial, and his lowest score 10 seconds, made in the second trial on the second day and in the final trial. The most erratic record, due to the subject's tendency to get "lost" was made by Subject I, whose worst score was 79 seconds, on the second trial on the second day, and whose best score was his final score of 23 seconds. Time without the mirror eleven seconds. For a comparison of the complete performances of these two contrasted subjects, see figure 3.

Of the six subjects in the three year old group, only one made his best score in the final trial, subject I. Three subjects, J, L, and Ll, did as well in the final trial as they had done once before. Two subjects, K, who made the best time of all in this group, 9 seconds, and M, made their best time on the second trial on the first day. Subject M, whose record shows the least consistent improvement without any spectacular set backs, is the youngest child in this group, being three years and four months old.

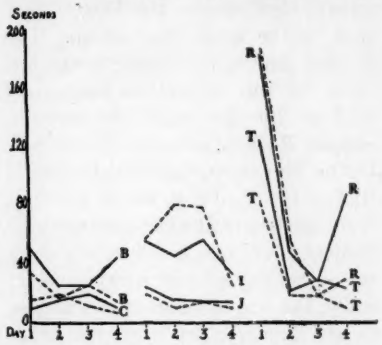


FIG. 3. EXAMPLES OF INDIVIDUAL DIFFERENCES FROM EACH AGE GROUP
——— first trial;---------- second trial

Two year old group. The lowest first score in the two year old group was made by Subject O, aged two years and nine months. (See table 1.) The

score was 20 seconds, not much slower than the shortest first trial in the three year group. This subject had little difficulty with the test, his poorest time was 26 seconds, made on the second trial of the third day, and his final trial, 10 seconds, was one of the two best final trials made by this group. His time without the mirror was 9 seconds.

The longest initial trial, 179 seconds, in the two year group was made by Subject R, aged two years and eight months. This time is almost a whole minute slower than the longest first trial in the three year group. The slowest time in this whole group was made by this subject on his second trial on the first day, 183 seconds, Subject R's final score was 25 seconds, but his best score, made on the second trial on the third day, was 17 seconds. A comparison of R's performance with Subject T's (fig. 3) is interesting as an example of two subjects who both start badly, but one of whom shows almost steady improvement while the other gets into difficulties even on the last day.

Half of the subjects in the two year old group made their best score in the final trial, one did as well in his final score as he had done once before. Of the other five subjects, one made his best score on the second trial on the first day, three made their best scores on the second trial of the third day, and one on the first trial of the last day.

Summary

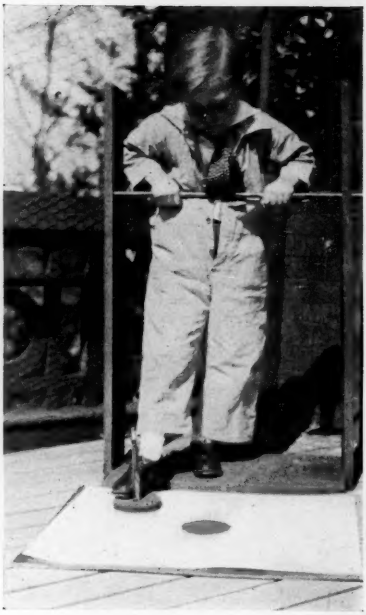
Clinton's conclusion that mirror drawing ability develops from year to year is strikingly upheld by a comparison of the performance of the three age groups. In the first trial there is practically no overlapping of the groups,—although on the third day the two year olds do better than the three year olds by two seconds. In the second trial there is some overlapping between the three year group and the other two groups, but none between the two and four year groups.

PROBLEM II

The subjects were the same as those used for Problem I, except that five had left school or were absent for such long periods that they could not be used. Of these children, one belonged to the four year old group, two, unfortunately, belonged to the three year old group, reducing it to only four members, and two were in the two year old group. This left 22 subjects who completed Problem II.

Apparatus and procedure

For the foot experiment, a large mirror was used, 92 centimeters square. This mirror stood upon the floor inclined against the wall of the experimenting room. Suspended from a wire above the mirror was a curtain which could be lowered to conceal the mirror. In order that the subjects would have something to hold on to while standing on one foot, an adjustable rack was used. This rack consisted of two boards, 15 centimeters wide and 92 centimeters long, nailed at right angles to the ends of a thick plank of corresponding width and 61 centimeters long which was used as the base. The boards used as uprights had holes 1.5 centimeters in diameter bored 5 centimeters apart in a per-



pendicular line to the base, along the outer edge. An iron rod inserted in the holes at about the right height for the child to hold thus gave a solid support for the child to grasp with both hands. In this way he could stand on his left foot and move his right foot freely without losing his balance (Plate I). Only three heights were actually used in this experiment. The stand was placed 123 centimeters in front of the mirror.

On the floor directly in front of the stand was laid a piece of beaver board 54 centimeters wide by 67 centimeters long, to which the sheets of paper for individual records were fastened with thumb tacks. The paper used for the records was Congress linen bond, cut in sheets 48 centimeters wide by 60.5 centimeters long. In the center of each sheet of paper a circle was drawn 10.5 centimeters in diameter. This circle was filled in solid with yellow paint.

The disc which the subject was to push with his foot, was of wood, 10.5 centimeters in diameter, and one centimeter in thickness. It was painted yellow to correspond with its destination. In the center of the disc a hole was bored to permit the insertion of the point of a large lead pencil. This pencil had a wire loop fastened just below the eraser, which was turned down toward the point of the pencil. A heavy strip of rubber, in length a little less than twide the distance from the loop to the point of the pencil, was passed through the loop and then both ends were pinned down together to the disc, as close to the edge of the hole as possible, in order that the pull of the rubber would force the pencil through the disc and thus make a mark whenever the disc was pushed along a smooth surface. Of course the pencil had to be adjusted from time to time, the point needing to be sharpened and the rubber stretched tighter to maintain the same tension, as the pencil grew shorter.

For a screen, a piece of card board 41 centimeters wide by 80 centimeters long was used. This screen was laid above the record sheet 53 centimeters from the floor, one end of the screen resting on a table, the other supported by a wooden box of corresponding height, one edge flush with the edge of the stand. In the case of the smallest children, the bar of the support was flush with the edge of the screen. Clamped to the edge of the table, underneath the screen, was an electric light, used on dark days to counteract the cutting off of light by the screen.

No record, other than time, was kept on the trial without the mirror, because the movement was so simple that there was practically no variation. For the direct vision trial, therefore, one record sheet was kept permanently fastened to a piece of beaver board and used over and over again. When the subject entered the experimenting room, the curtain was lowered over the mirror and the try-out sheet in position on the floor in front of the stand. The screen had been removed. The observer said: "Stand in here" indicating the space between the two uprights of the stand, "and hold on to the rod with both hands. Then you are to put your foot on this yellow block and push it onto the yellow cir-

cle, like this." (Demonstration). "Now, when I say 'Go' push the block onto the circle. Ready, Go."

After this had been accomplished, usually within a few seconds, the practice board was removed and replaced with the other similar board, with a fresh record sheet fastened to it with thumb tacks. The screen was put in position, the curtain lifted from the mirror, the disc placed on the record sheet in the lower right hand corner, with its rim 3 centimeters from each edge of the paper, so that movement could be made in any direction. The following instructions were then given: "Now do just what you did before, put your foot on the block and push it onto the yellow circle, when I say 'Go,' but this time you must look in the mirror to see where your foot is. Ready, go." Time was kept with a stop watch from "Go" until the subject completed the task to his own satisfaction, or until three minutes were up.

Only one trial was given each day, and only three trials were given, at intervals of three days with some exceptions. If a subject had his first trial on Thursday, he had his second on the next Monday and his third on the following Thursday.

The problem of scoring the records was a difficult one. A wooden frame was constructed the size of the record sheet. Tacks were placed on the frame at intervals so that a string pulled taut across the frame made blocks 15 centimeters square. At least the bottom and middle rows were square, the top row was several centimeters larger from top to bottom as the paper was not square, but this did not matter because the subjects could not reach quite to the middle of the top row. There were four squares from left to right and three from top to bottom. The middle line from top to bottom ran directly through the center of the circle. Thus, if the disc were pushed straight to the circle, it would traverse but one square. If the disc were pushed far enough to the left to get into the second square from the right side of the frame, that was counted one error to the left, if it were pushed into the third square from the right side of the frame that was counted two errors to the left. If the disc were pushed up into the middle square at the right, that was counted one error "up," and so on. Of course this system takes into account only gross errors with one exception: if the disc were moved percentibly to the right, or down, in the starting square this counted one error, as it could not possibly be moved more than three centimeters in these directions, as it came up against the box or stand; but as the movement was a gross one, this method seems admissible. Errors were only counted when the goal was attained within the time limit of three minutes. In the case of six subjects in the two year group, the stand was placed six centimeters on the record sheet so that the subjects could reach the goal.

Results

The results of the second experiment show a more definite cleavage in the abilities of the age groups than do the results of the first experiment. The three and four year old groups can be said to have mastered the problem in

the three trials given, with the exception of one subject, J, whose difficulty was emotional and whose case will be discussed later. The two year old group on the other hand seems, on the third day, to have reached about the stage of performance shown by the two older groups on the first day. That is, the average time of the 9 subjects who completed the experiment on the third day was 74.3 seconds and that of the four year old group on the first day was 74.5 seconds; the three year group (three subjects) has a lower

TABLE 2

Time and error record for age groups in experiment II

SUBJECTS		TIME WITHOUT MIRROR	1ST DAY		2ND DAY		3RD DAY	
			Time	Errors	Time	Errors	Time	Errors
		seconds						
Four year group	A	8	78	2	103	3	27	3
	B	10	127	6	9	1	9	4
	C	3	21	4	14	1	17	3
	D	4	20	3	11	4	7	1
	E	15	168	5	32	3	30	5
	F	5	18	5	18	4	5	3
	G	15	45	8	109	9	58	5
	H	3	119	8	97	5	25	1
Totals			596	41	393	30	178	25
Mean			74.5	5.1	49.1	3.7	22.2	3.1
Three year group	I	8	66	5	85	5	9	2
	J	10	DNC	—	DNC	—	DNC	—
	L	5	12	2	10	0	10	1
	M	4	34	1	62	12	50	7
Totals			112	8	157	17	69	10
Mean			37.3		52.3		23.0	
Two year group	O	8	17	1	DNC	—	81	7
	P*	10	DNC	—	16	2	59	3
	Q	10	DNC	—	DNC	—	110	5
	R	8	DNC	—	72	9	99	4
	S	5	86	3	DNC†	—	10	3
	T*	3	66	8	103	5	35	5
	U*	3	25	1	17	4	17	1
	V*	11	DNC	—	DNC	—	DNC	0
	W*	7	70	1	93	12	13	2
	X*	4	DNC	—	DNC	—	40	3
Totals			264	14	536	32	669	33
Mean			52.8		89.3		74.3	

* These subjects had the shorter distance.

† Completed after the time limit.

time, 37.3 seconds, due to individual differences, on the second day their time goes up to 52.3 seconds. In the two year old group, on the first day only, half of the subjects completed the experiment, the other half either becoming hopelessly involved in wrong movements or giving up after placing the block less than half-way on the circle. On the second day, 6 subjects succeeded in reaching the goal within the time limit and on the last day all but one were successful.

Both the average time and the average number of errors made by the four year old group shows a steady decrease from day to day as is shown in table 2. This is especially true of the time record, for although the errors decrease they do not fall off as rapidly as the time. In individual cases, there seems to be a discrepancy between the number of errors made and the time taken to finish the task. For example, in the four year old group on the first day, subject H makes 8 errors in 119 seconds, whereas subject F makes 5 errors in 18 seconds. This apparent disproportion is due to the fact that in this experiment a subject tended to become bewildered when his foot went in the wrong direction, and frequently stood without moving at all for considerable periods. In addition to this tendency to stand still on the part of the cautious subjects, there was the over activity of the quick moving child who kept moving his foot regardless of where it went, consequently reaching the goal in less time but with more errors. These two factors are important in all three groups.

In the four year old group, five subjects, A, D, E, F, and H made their best time score on the last day, and D, F, G, and H also made the fewest errors on the last day. The other subject, A, made his fewest errors on the first day. The fastest first score made in this group was 18 seconds, by subject F, who also made the best time on the last day, 5 seconds. Subject B was the slowest on the first day, taking 127 seconds, but she reduced this to 9 seconds the second day and took 9 seconds again on the last day.

The three year old group was composed of highly individualistic subjects. Subject J, after 65 seconds of fruitless effort, gave up, saying: "I don't want to do it any more. I want to go back to the other room." He kept on refusing to try any more until his three minutes elapsed. On the second day, he tried for 31 seconds, and then refused flatly to make any further effort. On the third day, he refused even to start. This subject is both spoiled and stubborn, and would not try to overcome the difficulties. In contrast to J's behavior is that of S who struggled on, almost weeping but determined to finish, succeeding in 3 minutes 50 seconds. Because of the time limit, he had to be scored D.N.C., but he was so absorbed and anxious to succeed that the observer let him continue over time.

The three year old group also contained subject I, whose tendency to get "lost" had appeared in the first experiment, and who ran true to form on the second day, running his time up to 85 seconds when it had been 66 seconds on the first day. He redeemed himself on the last day, cutting his time to 9 seconds and making only 2 errors. The only errorless record

made in the whole experiment belongs to subject L in this group. She also made the fastest time on the first day in any group, 12 seconds with 2 errors. On the second day she did it in 10 seconds with no errors, and on the third day in 10 seconds with 1 error. The other subject in the three year group, M, made the goal in 34 seconds with only 1 error on the first day, which must have been chance, because on the second day he wandered all over the paper, making 12 errors, and on the last day he improved only a little, bringing his time down to 50 seconds and his errors to seven.

vanquished. There is only one subject, U, in this group who made a consistently low record in both time and errors. All the others, on one day at least, took over 50 seconds except the youngest child in the group, X, who on the last day, after two failures, solved the problem in 40 seconds with three errors.

An analysis of the direction in which the errors were made shows the left predominate. (See table 3.)

Summary

The second experiment shows all three age groups learning new coördi-

TABLE 3

Analysis of errors

	LEFT	UP	DOWN	RIGHT
Four year old group	41	10	19	26
Three year old group	13	8	12	2
Two year old group	26	22	23	15
Total all groups	80	40	54	43

The situation which developed in the two year old group is difficult to account for, in view of the performance of this group in the first experiment. Had the two year olds been unable to learn the new coördinations thrust upon them by the mirror, well and good, but they learned it with the hand movement, although more slowly than did the older groups, and so just why the foot movement should prove more baffling to them seems obscure. On the first day only half the group met with success, on the second day two more were successful but one who had succeeded the first day failed, and on the third day only one remained

nations, but with more individual inconsistences than appeared in the first experiment. This is probably due to there being more of an element of chance success in this experiment, where one chance movement in the right direction brought success, whereas in the first experiment three movements had to be made. Skill in foot movements is probably less developed than in hand movements, and the greater variability might be expected under such conditions. A study of the acquisition of skill in this situation by an adult might throw light upon the relative difficulty of hand and foot coördinations.

PROBLEM III

The subjects in this experiment were the same as those used in Problem II, that is, 22 children ranging in age from two years and one month to five years and four months. Seventeen of them were boys and 5 were girls.

Apparatus and procedure

The set-up for this experiment was the same as that for the first experiment, except the task to be done and the materials for that task. The same table and chair, the same mirror and screen were used as in Problem I. In place of the board, cup, and three objects, a sheet of white paper 35.5 centimeters long by 21.7 centimeters wide was fastened to the table with thumb tacks, the long edge flush with the front edge of the table. On the paper was a path, 4 centimeters wide, running the length of the paper. At one end this path was in the center of the paper, and starting from that end as the right hand end the path ran 10 centimeters and turned at a right angle to the left for 3.5 centimeters, turned another right angle to the right, continued straight for 9 centimeters, turned another right angle to the right, ran straight for 9.5 centimeters and turned at a right angle to the left and continued straight to the edge of the sheet. This was the direction used for the main part of the experiment. For the control test without the mirror, the paper was reversed so that the path started in the lower right hand corner.

A toy cannon, its two wheels 2.3 centimeters apart, was used to push along the path. Underneath the cannon and between the wheels a pencil stub was fastened so that a line was drawn as the cannon was moved along. When the child came for the first time for this experiment, the screen was swung around to the right out of the way, the paper was in place on the table, with the path starting in the lower right hand corner. After the child was seated, the observer said, "See this road that is drawn here on the paper? I want you to push this cannon along that road as fast as you can without getting off the road. Now, hold the cannon this way." The child's fingers were placed around the cannon just above the pencil; "and when I say 'Go' push the cannon along the track, and be sure to stay in the road." Then observer places child's right hand, now containing the cannon, in the middle of the path at the edge of the paper, and says, "Ready, go," at the same moment releasing the child's hand. Time was kept with a stop watch until the cannon reached the other end of the paper, or for the two year olds until three minutes elapsed.

Then the paper was replaced with a fresh sheet turned around the other way, the mirror was put on the table and the screen swung into position so that the path was concealed from view except in the mirror. The child was moved close up to the table and asked, "Can you see all of the road in the mirror?" If not, the mirror was adjusted until he could see the whole path. Then observer placed the cannon in the child's hand and placed the hand containing the cannon in position in the middle of the track at the end of the paper, saying, "When I say 'Go,' do what you did before, push

the cannon along the road, being sure to keep in the road, but now you can only see it in the mirror, which you remember makes it look different. Ready, go." The hand was released at "Go." Time was kept with a stop watch until the cannon reached the other end of the paper or until five minutes had elapsed for the three and four year olds and three minutes for the two year olds. Occasionally, the observer reminded the subject that the cannon must be kept in the path.

Two trials were given with the mirror each day, for four days, at approximately three day intervals. That is, the experiments were made on Mondays and Thursdays for two consecutive weeks. In order to score the record of the cannon's meanderings left on the paper by the pencil, the following method was used. A scale of three units was made, each unit being one-third of the distance from the path to the top of the sheet, at the right hand end when the paper was in position for the mirror experiment. The scale was marked on a piece of paper and used to measure the distance the cannon had been pushed from the path. If the cannon were pushed off the track but not further than a distance of 2.8 centimeters the first unit, it was counted one error. If the trail of the cannon was found in the second zone, it was counted as two errors; if in the third zone, as three errors. Thus, if the mark of the cannon was found off the track twice in the first zone, once in the second zone and once in the third zone, the score would be seven errors. The distance was measured from the point at which the cannon left the track to the most distant point that the cannon reached before it returned to the track.

Results

The third experiment shows a clear break between the two year old group and the three and four year old groups. Not one of the two year olds completed this experiment. Of the three year old group, two succeeded and two did not; the two who failed undoubtedly did so because of emotional difficulties to be discussed later. All of the four year old group completed the experiment, but three of them, subjects B, F, and G, failed on the first trial the first day.

Subject F was so upset by her first trial that she was not given a second trial that day, but B and G succeeded on the second trial although their time and error score was well above the mean, as is shown in table 4. On the second day subject F made no objection to trying again and did remarkably well. On both trials both her time and error scores were below the mean for the group. In fact this subject, with one trifling exception, improved steadily not only from day to day but from trial to trial. Her final score, 11 seconds, with no errors, was the best final score made by anyone, and her time was also the best made by any subject in any trial, although there were three other records made without errors.

The best initial score in both time and errors was made by subject H, 45 seconds and 1 error. He then slumped, becoming worse until on the second trial on the second day his time score was 149 seconds with 6 errors. Then he began to improve slowly and fin-

TABLE 4

Time and error score—four year group

SUBJECTS	WITHOUT MIRROR		1ST DAY				2ND DAY				3RD DAY				4TH DAY			
			1st		2nd		1st		2nd		1st		2nd		1st		2nd	
	T*	E†	T	E	T	E	T	E	T	E	T	E	T	E	T	E	T	E
A	15	1	103	7	153	19	71	4	27	2	35	3	20	4	30	4	19	2
B	30	1	DNC	—	131	13	150	14	130	6	118	10	57	6	59	3	27	4
C	10	1	69	5	36	5	43	3	27	4	32	3	28	4	24	4	17	2
D	17	4	85	11	43	12	55	7	50	14	142	11	80	5	31	5	29	4
E	39	1	265	24	132	7	144	5	63	5	80	3	57	1	67	2	39	3
F	21	0	DNC	—	—	—	59	3	27	5	13	0	12	0	16	1	11	0
G	45	0	DNC	—	250	13	100	6	92	7	29	3	62	5	61	3	65	4
H	35	0	45	1	77	8	135	16	149	6	79	2	76	3	73	4	42	4
Totals....	212	8	567	48	822	77	757	58	565	49	528	35	394	28	361	26	249	23
Mean.....	26.5	1.6	113.4	9.6	117.4	11	94.6	7.2	70.6	6.1	66	4.3	49.2	3.5	45.1	3.2	31.1	2.8

* T is time in seconds.

† E is errors.

TABLE 5

Time and error score

Three year group

SUBJECTS	WITHOUT MIRROR		1ST DAY				2ND DAY				3RD DAY				4TH DAY			
			1st		2nd		1st		2nd		1st		2nd		1st		2nd	
	T*	E†	T	E	T	E	T	E	T	E	T	E	T	E	T	E	T	E
J	34	6	DNC	—	—	—	DNC	—	—	—	—	—	—	—	—	—	—	—
L	30	1	89	21	80	13	128	8	87	5	90	9	57	3	95	8	39	2
I	20	1	DNC	—	—	—	DNC	—	—	—	—	—	—	—	—	—	—	—
M	10	0	DNC	—	—	—	DNC	—	—	—	85	0	130	8	72	3	37	4
Totals....	94	8	89	21	80	13	128	8	87	5	175	9	187	11	167	11	76	6
Mean.....	23.5	2.6									87.5		93.5	5.5	83.5	5.5	38	3

Two year group

SUBJECTS	WITHOUT MIRROR		1ST DAY		2ND DAY	
	T	E	T	E	T	E
O	15	3	DNC	—	DNC	—
P	87	12	DNC	—	DNC	—
Q	16	4	DNC	—	DNC	—
R	45	12	DNC	—	DNC	—
S	DNC	—	DNC	—	DNC	—
T	20	3	DNC	—	DNC	—
U	DNC	—	DNC	—	DNC	—
V	DNC	—	DNC	—	DNC	—
W	8	0	DNC	—	DNC	—
X	DNC	0	DNC	—	DNC	—

* T is time in seconds

† E is errors.

ished with a final score of 42 seconds with 4 errors. H was the youngest child in the four year old group, and the observer believes that the explanation of his record is lack of sufficient motivation. He was interested in the first trial and thereafter became careless, but finally began to improve again.

The longest first trial was made by subject E, 265 seconds, who also in that trial made the most errors, twenty four. E improves with regularity from day to day, his final score being 39 seconds with three errors. (Subject C's record is typical; see Plates II and III.)

In spite of individual differences, the mean of the four year old group shows steady improvement in both time and error scores from day to day and of the second trial over the first, with the one exception that the second trial on the first day is slower and shows more errors than the first trial on the first day. (See fig. 4.) In this group, all but one subject, G, made their best time in the final trial, and of these seven, four also made the fewest errors in the final trial.

In the three year old group, we have two subjects, J and I, who refused to finish the experiment. (See table 5.) J, who with direct vision took 34 seconds and made 4 errors, took his hand away from the cannon after ninety seconds with the statement, "I can't do it" and thereafter refused to revise his opinion. On the three succeeding days, he would accompany observer to the experimenting room without demur, seat himself in the chair and after one or two efforts to make the first turn would desist, folding his hands in his lap and repeating in a whiny tone, "Can't do it."

Although the result was the same, subject I's behavior was very different. With direct vision, he finished in 20 seconds with only 1 error. On the first trial with the mirror, he struggled for 137 seconds and then suddenly shouted, beginning to jump up and down, "It won't go! it won't go!" On being urged to try a little longer, he tried to look under the screen and had to be forcibly restrained. Whereupon he said, "I won't do it any more,"

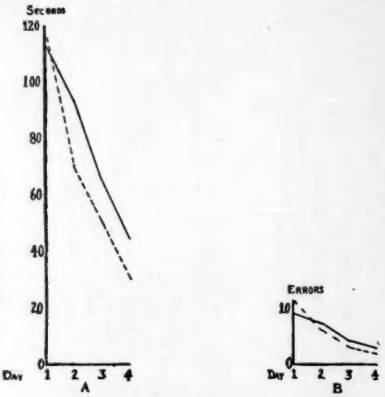
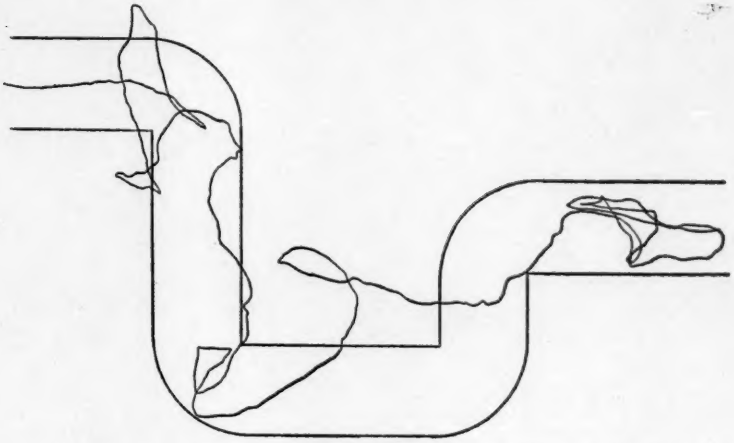
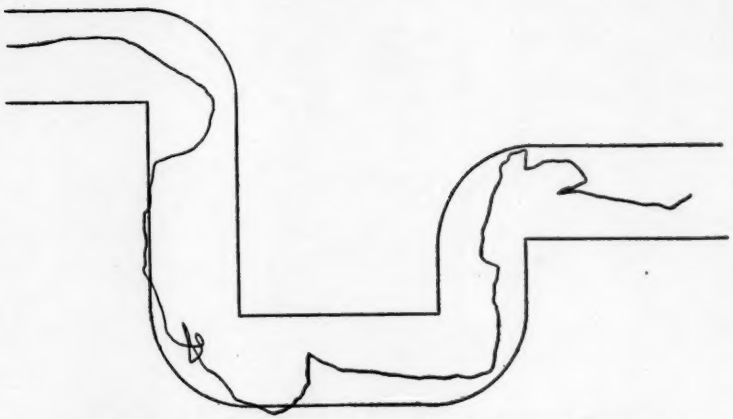


FIG. 4. A: MEAN TIME FOR PUSHING CANNON ALONG PATH, FOUR YEAR OLD GROUP; B: MEAN ERRORS
——— first trial; ---------- second trial

and he would not. On the second day something of the same sort occurred, only this time he gave up after forty seconds. On the third and fourth days he pulled the cannon out from under the screen and pushed it along on top of the screen, never once making an effort to do the test as instructed. The observer later tried a special inducement, offering him a cannon like the experimental one to keep, if he would try to do the experiment, but he screwed himself up into a ball of



SUBJECT C. FIRST TRIAL, FIRST DAY. TIME: 69 SECONDS; ERRORS: 5



SUBJECT C. LAST TRIAL, LAST DAY. TIME: 17 SECONDS; ERRORS: 2

rebellion and said "It won't go and I won't try to make it go."

Only one subject in the three year old group succeeded the first trial. This was subject L, who took 89 seconds and made 21 errors on the first trial, but in the final trial she had cut down her time to 39 seconds and her errors to two. Subject M, the youngest child in the three year group, struggled valiantly until the five minutes were up, never getting beyond the first curve and remarking once, dispassionately, "It always goes that way," meaning the wrong way. He did not want to try again that day, but came willingly the next experimenting day. This time he succeeded in reaching the last turn just as his time was up, but seemed unwilling to make a second attempt that day. On the third day, he was successful in 85 seconds without a single error, on the first trial. On the second trial, which he wanted to make, he took 130 seconds and made 8 errors. Was this caused by fatigue? On the fourth day, his time was 72 seconds with 3 errors on the first trial, and 37 seconds with 4 errors on the second trial.

The reaction of the two year old group to the mirror part of the experiment was uniform, but surprising differences developed in the direct vision part of the test. Four of the ten two year old subjects could not, or would not, do even the direct vision part of the experiment. They seemed not to understand what was wanted, and just pushed the cannon aimlessly back and forth without regard to the path. Although they were given a second trial on the second day, they again failed completely. These four subjects were S, V, U, and X, among the youngest children in the group, X being the youngest. But W, the next to youngest made a perfect record in 8 seconds with direct vision. He was hopelessly lost, however, with the mirror and just pushed the cannon back and forth, back and forth till the time was up.

The six subjects who succeeded in the direct vision trial were given two trials with the mirror, one right after the direct vision and one on the next experimenting day. As they showed no change in behavior whatever, unless perhaps more boredom and tendency to play on the second day than on the first, they were not given any further tests.

Summary

This experiment is interesting not only as showing up clearly the mirror adaptability of different age groups but also the cleavage between the two and three year old performance in other test situations, i.e., the failure of nearly half of the two year olds to do the direct vision part of the experiment. The increased difficulty of this experiment also brought out strongly the emotion connected with the effort to learn the new hand and eye coördinations.

SUMMARY AND CONCLUSIONS

In order to ascertain whether very young children could learn new eye and hand coördinations three experiments were devised. First, a simple task of picking objects up and putting them in a cup, the cup and objects being visible only in a mirror; second, an experiment with foot movements

in which the subjects pushed a disc with their foot from one position to another, foot, disc, and goal seen only in a mirror; and third, an experiment in which the subjects pushed a toy cannon along a path guided by the pattern seen in a mirror. In the second and third experiments, a pencil mark was left by the disc and cannon showing the course pursued on the way to the goal.

The subjects ranged in age from two to five years and were divided into three age groups, two, three, and four year old groups. There were 27 children in the first experiment and 22 in the second and third experiments. There were more boys than girls.

All three experiments show definite learning, and all three experiments show clear age differences, these differences becoming more marked as the difficulty of the experiments increases. All the subjects completed the first experiment, all the four year olds completed the second experiment as did all but one in each of the other age groups. None of the two year olds completed the third experiment. Only half of the three year olds but all of the four year old group finished the third experiment.

Conclusions

The results of the three experiments used in this investigation are so definite and clear cut that in spite of the few subjects used certain conclusions seem justifiable. Children as young as two years acquire skill in tasks requiring new hand and eye coördinations in movements that are in opposition to those demanded in the ordinary environment. Young children learn such new habits more slowly than do adults, and learning proceeds more rapidly and more accurately as age increases. Age differences in adaptation to such situations as the mirror experiments present, are closely related to the complication or increasing difficulty of the coördinations involved. Mirror experiments bring out emotional tendencies in children that merit consideration in the guidance of the child.

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Brief Reports
A Correction

IN THE issue of CHILD DEVELOPMENT for December, 1930, a brief report on Skill in Progressive Movements of Children by Johnson and Courtney included a table for results from the Walking Board Test. Due to the omission of a few decimal points the total scores and averages for longest distance walked are incorrect. The correct tabulation should be as shown in table 1.

BUFORD JOHNSON,
The Johns Hopkins University.

TABLE 1
Walking board

CASE NUMBER	CHRONOLOGICAL AGE		LONGEST DISTANCE							
	Years	Months	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8
			inches	*inches*	*inches*	*inches*	*inches*	*inches*	*inches*	*inches*
1	4	8	30	55	35	35	25	40	115	60
2	4		90	135	60	85				
3	4	5	105	55	65					
4	4	4	75	32.5	135	135				
5	4	5	95	135	90					
6	4	10	117.5	80	67.5	57.5				
7	4	5	135	50	95	120				
8	4	8	135	67.5	27.5	50				
9	3	7	45	20	35	25	25			
10	4	4	22.5	27.5	35					
11	4	9	135	90	135	135	110			
12	3	9	47.5	70	40					
13	4	10	70	65	75	70				
14	4		40	25	55					
15	3	11	20	30	40					
16	4	1	35	25	55					
17	5	1	85	135	80					
18	4	3	60	85	75					
19	3	2	15	80	20	50	40			
20	2	8								
21	3		5							
22	2	7								
23	4	3								
24	3	4	50	40						
25	3	7	40							
Total			1,452.5	1,302.5	1,220.0	762.5	200			
Average			66.02	65.13	64.2	76.25	50			

Temperature Variations in Normal Pre-School Children

WHAT variations in body temperature are normal in healthy pre-school children? This problem was studied among a group of nursery school children at the University of California Institute of Child Welfare. Daily rectal temperatures were recorded at 9:00 a.m., 11:00 a.m., and at 1:00 p.m. until at least five records were obtained for every child at each period. It was first determined on a small number of cases that averages of five readings as compared with averages of ten readings were reliable and sufficient for our purposes. Eighteen children from 20 to 52 months of age were systematically studied in this way. The nursery school group included only normal, healthy children. This was determined at the time of application for admission, on the basis of information concerning such health items as: height and weight, disease history, frequency of colds and digestive disturbances, and the like. Daily medical inspection excluded all children suffering from acute infections, such as colds, and a complete medical examination at least twice a year served to check up on the general physical condition of the children. As an indication of the normality of the group, no child was more than 3¼ pounds underweight during the period of this study. Additional records were obtained on 7 children after active play in sun suits at 11:00 a.m., and at 3:00 p.m. after a nap. The conditions under which sunbaths were taken were not sufficiently uniform to warrant presenting the data in detail.

From these records it has been possible to obtain data concerning: (1) characteristic temperature fluctuations for individual children, and (2) average temperature variations for the group in relation to time of day, sex, age, and activity.

PROCEDURE

The first temperatures were taken at nine o'clock each morning, after health inspection. A certified clinical thermometer of standard make was inserted into the rectum approximately three centimeters, so that the bulb was well covered. Care was taken to insert the thermometer deep enough so that it could not be affected by outside air, and to insert it the same length each time so as to obtain comparable results. According to Benedict and Slack (1), the rectal temperature rises as the distance from the outside increases, until the highest point is reached at the depth of 6 or 7 centimeters, but the curves for temperatures taken at different distances are parallel. The same procedure was repeated at 11:00 a.m., 1:00 p.m., and 3:00 p.m.

RESULTS

Averages and average deviations

The average for the total series of records is 99.5°F. There were no differences in the average for boys as compared with girls, nor for the younger as compared with the older children, although the group average is distinctly higher than the rectal temperature which Howell (2) reports

as normal for healthy adults, (98.96). In comparing the average temperatures on different days of the week, the slight differences found were unreliable.

In this group of apparently healthy children the lowest temperature recorded was 97.7, taken at 3:00 p.m. after a nap. The highest temperature, taken after a sunbath, was 101.7.

It was found that we not only had individual differences in regard to the amount of fluctuation in temperature readings, but that we also had some individuals whose temperatures registered consistently higher or lower than the average. One child had an average of all temperatures as high as 100.0, and another as low as 99.2. Fig. 1 illustrates the temperature fluc-

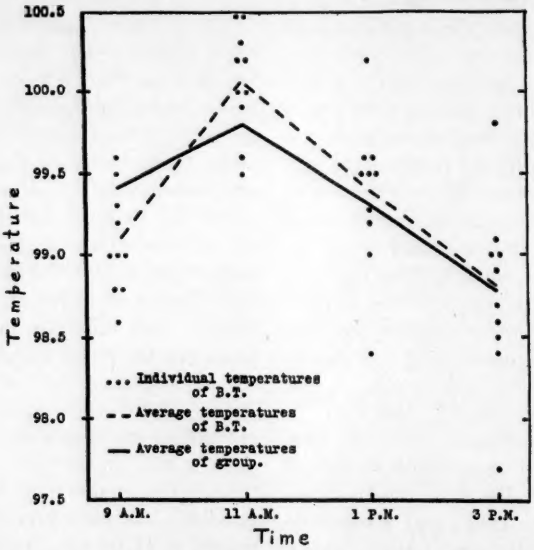

FIG. 1. FLUCTUATION OF RECTAL TEMPERATURES OF B. T. AT VARIOUS TIMES OF DAY

Considering only the temperatures taken under the usual conditions at 9:00 a.m., 11:00 a.m., and 1:00 p.m.; the lowest was 98.0 and the highest 101.0. All children showed fluctuations in temperature from day to day. The lowest average deviation was .072 (five readings, at 9:00 a.m.) and the highest .664 (five readings at 11:00 a.m.).

tuations for a child whose temperature showed about average variability as compared with the group. Fig. 2 shows the temperature curve for L. J., whose temperature ran high consistently, and for E. T., whose temperature was low consistently.

Although children showing the greatest variations from the norm may have had some physical complication

which did not show up in the physical examinations given at the nursery school, it is very unlikely that every temperature of 100 indicated illness. Every child in our group had at least one temperature of 100 or over at 11:00 a.m. Over half had a temperature of at least 100 at 9:00 a.m., with no obvious indications of ill health.

By compiling the data for the group as a whole further results were obtained as shown in table 1. The A.D. is here used to signify the average deviation from the mean of the average temperature for each child. At 9:00 a.m., approximately 50 per cent of the children yield average temperatures falling between 99.2 and 99.6. At 3:00 p.m., the middle 50 per cent of the children have averages between 98.6 and 98.9.

At 11:00 a.m., when the highest temperatures were recorded, the children were finishing an active two-hour play period out-of-doors; the findings agree with those of other writers (Abt, Benedict and Slack, Woodhead and Varrier-Jones) who have noted that muscular activity and bodily exertion promote a rise in temperature. The 1:00 p.m. temperatures, which were lower, followed a period of relative quiet. The children washed for lunch, rested on cots for 15 minutes, and ate lunch in a leisurely fashion. Woodhead and Varrier-Jones (3) have reported that digestion

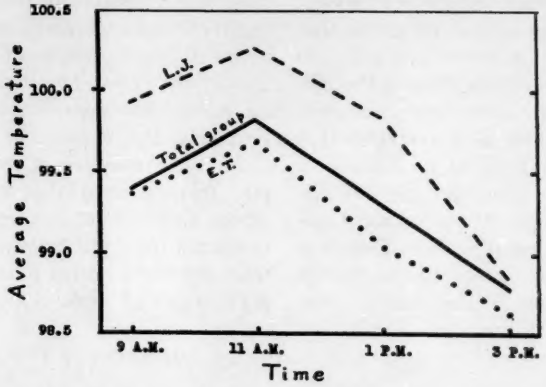

FIG. 2. AVERAGE TEMPERATURE CURVES OF L. J. (CONSISTENTLY HIGH), OF E. T. (CONSISTENTLY LOW), AND OF TOTAL GROUP

TABLE 1

Temperature variations in relation to the time of day

	NUMBER OF CASES	MEAN TEMPERATURE	A.D.
9:00 a.m.	18	99.395	.219
11:00 a.m.	18	99.83	.193
1:00 p.m.	18	99.31	.153
Average of 9:00 a.m., 11:00 a.m. and 1:00 p.m. temperature	18	99.51	.153
3:00 p.m.	7*	98.78	.139

* This group of seven children had mean temperatures at 9:00 a.m., 11:00 a.m., and 1:00 p.m. that were the same, through the first decimal place, as those for the entire group of 18 children.

of food is responsible for a rise in temperature, but that there is a slight drop immediately after eating and before the rise begins.

From 1:00 until 3:00 p.m. the children rested on cots in quiet, airy, rooms. All but one or two of the oldest children slept for most of the period. It was just after this rest period that the lowest temperatures were recorded. Although it is the general opinion that temperatures tend to be highest in the late afternoon, the effect of the rest period apparently offset this tendency, at least temporarily. There was no opportunity to record temperatures at a later hour as the children were called for and taken home shortly after their naps.

CONCLUSIONS

This brief study of temperatures in normal children shows the daily variability in temperatures, and the individual tendencies of children to depart from the average. It is well to remember that each child has his own range of temperature, and that muscular activity, food, and clothing must be taken into consideration in determining the importance of variations. The chart of a child's "normal" temperatures, taken at a nursery school, should be of some value in interpreting the significance of temperatures registered during illness, or during a suspected incubation period.

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Laughter in the Pre-School Child

PROBLEM

A STUDY of laughter in children of pre-school age was made in order to contribute, if possible, to the solution of the following questions:

1. What are the causes of laughter in children of pre-school age?
2. Do the causes of laughter vary with age?
3. Does the occurrence of laughter vary with
   a. Age?
   b. Social contact?
   c. Intelligence?

METHOD

1. From February to June 1931, record was kept of laughter on the part of the children enrolled in the Nursery School of Vassar College. These observations were made for an hour at a time at five different periods during the week. It must be borne in mind that the results are based upon observations made at different periods during the day and are in no sense a complete record of the incidence of laughter throughout the period of study.

2. Four toys were exhibited to the children individually and in groups. The toys were placed under a cover which each child was allowed to remove for himself and discover what was underneath the cover. The reactions of the children to these toys were noted. The toys were: (a) A spotted dog with movable ears and tail; (b) a spotted rubber dog who squeaked and whose head and tail were moveable; (c) a clown with a fur body hung on an elastic string; (d) a jumping jack.

RESULTS

1. Observation in the nursery school

From direct observation, the observer found that the incidence of laughter noted fell under the following headings:

a. Motions made by the child himself, by other, or by objects.

b. Noises made by the child himself, by others, or by objects.

c. Socially unacceptable situations.

d. Grimaces made by child himself or by others.

e. Inferiority in others.

f. Pleasure of child in occupation or accomplishment.

g. Situations showing appreciation of humor.

h. Word play.

i. Imitative laughter.

j. Situations involving make-believe.

k. General well-being and happiness.

2. Presentation of toys

On the whole, the experiment of showing the four toys to the children was not very successful in causing laughter. Interest and curiosity, rather than amusement, were shown by nearly all of the children. When summarized, these results show that out of 100 possibilities for laughter, only 12 real laughs occurred, while there were a 9 laughs or snickers, and 60 smiles.

As a test of the social element in laughter, these toys were presented to groups of the children. There was not any marked increase in the laughter caused. All of Group I smiled at each of the toys, but none really laughed. In Group II, one laughed heartily, although she had not laughed at all when the toys were presented to her alone. In Group III only one child laughed and her laugh was rather one of excitement than amusement. One child in Group III laughed at the very beginning seemingly in anticipation; one smiled, and one laughed heartily at all of the toys. He also had not really laughed when the toys were presented to him alone.

Results from the direct observations, however, seem to show that children very seldom laugh except when in the presence of others. Out of the 223 situations in which laughter was noted, only 14, or 6.3 per cent occurred when the child was alone.

3. Laughter and intelligence

Of the 16 cases including Intelligence Quotients ranging from 100 to 130, the average was 118.06 and the average number of laughs, four and seven tenths

There were 10 cases of intelligence that were markedly above the average. The average Intelligence Quo-

tient of this group was 140.6 and the average number of laughs, thirteen.

CONCLUSIONS

1. The children of pre-school age studied in this paper laughed most frequently at situations which involved motion of self; second, at situations which they realized were socially unacceptable; and third, at humorous situations.

2. The laughter of the two-year-olds was caused most by motion of self; next by socially unacceptable situations; and third, by pleasure in occupation and accomplishment. The three-year-old group laughed most frequently at the socially unacceptable situations; next at situations involving make-believe; third, at situations showing appreciation of humor; and fourth, motion of self. The laughter of the four-year-old group was caused most frequently by motion of self; next by situations socially unacceptable; third at those showing appreciation of humor.

3. In the two-year-old group, for the period studied, the average number of laughs for each child was fourteen; in the three-year-old group the average was six and two tenths; and in the four-year-old group the average was six and five tenths.

The presence of other children does, for the most part seem to be an essential element in the occurrence of laughter in children. That is, children seem to laugh very seldom alone, although the mere presence of other children does not necessarily mean that there will be increased laughter.

The results from the group of children studied seem to show that there is some correlation between the amount of laughter and the intelligence of the child; those having a higher I.Q. laughing more frequently.

MARGARET KENDERDINE.

A Study of Fifty Home Libraries with Special Reference to Their Function in Child Development

THE investigation which is described in this paper consisted of quantitative and qualitative appraisal of 50 home libraries with special reference to their function in child development. The data for the study were gained through interviews with the mothers in their homes and through actual examination of the reading materials found in each family library. Morris, Illinois, a city with a population of 6,000 was chosen as the location of the survey. A total of 162 children was found in the 50 homes, ranging from homes with an "only child" to homes with as many as 10 children. The average number per family was three.

Of the 50 homes visited, 38 were found in which both parents were native-born, 8 in which both were foreign-born, and four in which one was foreign-born and one native-born. There were wide variations in the occupa-

tional classification of the fathers. Using Taussig's classification, 32 per. cent of the fathers may be classified as unskilled laborers, 18 per cent as skilled laborers, 32 per cent as business men, and 18 per cent as professional men. The educational status of the parents presented further variation. Of the parents interviewed, 8 per cent had not finished grammar school, 38 per cent had completed the grades, 8 per cent had not finished high school, 24 per cent had graduated from high school, 4 per cent had not finished college, and 18 per cent had graduated from college. In addition, 18 per cent of the fathers had received professional training, as medicine, law or theology.

It is thus evident that there was great variation in the nativity of parents, occupational classification, educational status, and size of family in the 50 homes studied. It is believed that a fair cross-section of the community was secured. The occupational and nationality distribution of this sampling corresponds very closely to the 1931 government figures for the city as a whole, furnished by Leon E. Truesdell, chief statistician for population.

Records were made of the total number of books, magazines, and newspapers, as well as lists of the titles of children's books and magazines and child study books and magazines found in each home. The average number of newspapers was two subscriptions per family. The most common dailies were the local paper, *The Morris Herald*, and *The Chicago Tribune*. The average number of magazine subscriptions per family was five. The most common magazines were *Good Housekeeping, Ladies' Home Journal, Saturday Evening Post, Wommans' World, The Literary Digest, National Geographic*, and *The Parents' Magazine*.

Inasmuch as the special interest of the investigation was in regard to the home library as an agency of child development the number of children's magazines is of special significance. An average of one subscription per family was found. The most popular children's magazines were *Child Life, American Boy, Young Crusader, Junior Home*, and *Youth's Companion*. In regard to child study magazines, an average of less than one subscription per family was found. The two most common child study magazines were *The Parents' Magazine*, and *Child Study Magazine*.

A total of 150 books was found to be the average number per home. An average of 22 children's books per family was found. The five children's books found most frequently were Andersen's Fairy Tales, Stevenson's Treasure Island, Barrie's Peter Pan, Sewell's Black Beauty, and Spyri's Heidi. The ten most common children's authors were Perkins, Twain, Anderson, Alcott, Kipling, Stevenson, Spyri, Hurlbut, Barrie, and Sewell. In regard to books on the subject of child development an average was found of two books per family. The most common titles were: Galloway—Parents and the Character Training of Children, Waddle—Introduction to Child Psychology, Gruenberg—Guidance of Childhood and Youth, and Tanner—The Child. Over half of the child study books owned in these homes were popular rather than scientific.

This statement is not meant to disparage material written in a popular manner. It is of importance, however, that the facts and principles given be accurate. The four titles which were most frequently found are standard volumes in child study, but these titles represent only a small proportion of the total child study books owned in the homes. Over half of the books were titles found in only one home each.

The mass of data may be viewed from several angles other than group averages and frequencies. Tabulations were made of the results according to nativity of parents, occupational class, educational status, and number of children in family. Because of the small number of cases in the groups as well as the small size of the means in general, the averages are to be interpreted only as indicating possible tendencies. There is no assurance whatever that the differences between groups are in any way significant. When the 50 homes were grouped according to occupational class there was an increase in the size and quality of the home library which paralleled the rise in socio-economic status. When the homes were classified according to educational status of parents there was a general increase in the size of the home library along with increased educational opportunity, and a uniform improvement in the quality of the reading materials. When the homes were grouped according to nativity of parents there was no significant difference in the size or quality of the libraries of the different groups. When the homes were classified according to number of children in family there was no evident increase or decrease in proportion to the size of the family, although families with few children showed higher averages than those with from six to ten children.

We have already stated that the home libraries were judged qualitatively as well as quantitatively. The problem was to find a measuring stick by which to evaluate the children's books found in the homes. This required a review and careful analysis of the literature in the field of children's reading. After reviewing all available research in the field the following criteria were formulated:

1. The books should possess literary merit.
2. The books should have personality-orientation value.
3. The books should possess interest value for children.
4. The books should be adapted to the age and reading ability of the child who uses them.
5. The physical make-up of the books should be attractive to children and in harmony with hygienic requirements of printed materials.

More difficult than formulating the standards was the problem of finding objective judgments on the worth of specific books. After carefully studying the methods used in the compilation of 28 book lists, the "Winnetka Graded Book List" and "A Guide to Books for Character" (the Iowa Institute of Character Research study) were selected as the lists to be used in evaluating the fifty home libraries. These two lists were equated on a sigma unit scale and numerical

scores were assigned for literary merit and personality orientation value, and interest value for boys and for girls.

The literary merit of the children's books found in these homes was very low as measured by the criteria established in this study. In these homes children's books seem to have been selected on the basis of interest rather than literary merit and personality-orientation value. The interest value of the books was high both for boys and for girls. In regard to the age and grade suitability of the books found in these homes, the general tendency seems to have been to accumulate books with little regard to their suitability for the children of a given home. This is shown by the fact that in many homes practically all the books were adapted to one or two age-levels. Hence some children had an abundance of appropriate reading material, whereas other children in the same family had no suitable material.

In the homes included in this survey the size of the home library appears to be decreasing. This statement is based on the testimony of mothers that crowded living conditions and frequent moving make the ownership of large libraries impossible, even where the cost of books is not an important economic factor. The general trend is to substitute newspaper and magazine material for books. The lower cost and easy means of disposal when read were reported the important factors in this change.

Growing out of this study are several suggestions for those outlining the progress of child study in the home. Present knowledge concerning children's reading interests and needs might well be incorporated in the curricula of child study groups. At present in many localities the emphasis seems to be largely on the physical welfare of the child. Attention could well be directed to subjects such as providing adequate reading facilities for children in the home.

There is a definite need, at least in the locality in which this survey was made, for a parents free book review service which would give critical evaluations of children's books and help to counteract the effects of high-powered salesmanship in the field of children's books. The mothers interviewed stated that they had no means of knowing what books to buy except as they accepted the recommendations of book agents.

There also seems to be urgent need for the re-writing of child study materials for various levels of educational background. Much of the authentic child study material which is at present recommended to parents is written in a technical manner which presupposes college training. Parents who have not had such training reported that they find these books practically useless, and if interested must rely on popularly written material which is often unscientific.

GERTRUDE HILL NYSTROM.

Some Factors Affecting the Night Sleep of Children

RECORDS of the night sleep of 34 pre-school children were obtained from parents of the Washington Child Research Center for a period of 30 days. Each parent observed and recorded the time the child went to bed, went to sleep and awakened. There were 15 two-year-olds, 14 three-year-olds, and 5 four-year-olds.

Analysis of 1020 records (30 for each child) showed only slight differences between the three age groups in the average time the children went to bed, went to sleep, and awoke.

It was found that the average length of the night's sleep of the 3 groups was nearly equal. The two and three-year-olds slept 11 hours and 6 minutes, while the four-year-olds slept 11 hours and 2 minutes. Apparently the length of the night sleep of the children did not decrease with increasing age.

It was thought that the two-year-old children would go to sleep much quicker than three or four-year-olds. The reverse was true, for the three and four-year-olds were asleep on the average in 20 minutes, while the two-year-olds took 27 minutes.

The results of 3 rank-order correlations may be seen in table 2. These correlations indicate that the later the children were put to bed the longer it took them to go to sleep, and the later they awoke in the morning. However, their total length of sleep was

TABLE 1

Night sleep of 34 pre-school children

AGE	TIME IN BED		TIME ASLEEP		TIME AWAKE	
	Average	S.D.	Average	S.D.	Average	S.D.
years		*minutes*		*minutes*		*minutes*
2	7:24 p.m.	23	7:51 p.m.	26	6:58 a.m.	24
3	7:38 p.m.	19	7:58 p.m.	20	6:46 a.m.	20
4	7:31 p.m.	14	7:51 p.m.	24	6:54 a.m.	27
All ages	7:31 p.m.	19	7:53 p.m.	23	6:53 a.m.	23

TABLE 2

Variables of night sleep

RANK ORDER CORRELATIONS	2-YEAR OLDS*	3-YEAR OLDS†	4-YEAR OLDS‡
Time of going to bed—length of time required to go to sleep	−.60	−.02	−.43
Time of going to bed—total length of sleep	−.96	−.47	−.03
Time of going to sleep—total length of sleep	−.88	−.56	−.10

* Correlations based on 450 records on 15 children.
† Correlations based on 420 records on 14 children.
‡ Correlations based on 120 records on 5 children.

shorter than that of children who went to bed earlier. The rank-order correlations between length of sleep and intelligence quotient were as follows: two-year-olds −.43, three-year-olds −.27, four-year-olds −.20. These correlations indicate that children with higher intelligence quotients got less sleep than children with lower intelligence quotients.

MARGARET RICHIE WHITE.